MASSACHUSETTS
AGRICULTURAL EXPERIMENT STATION

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Annual Report

For the Fiscal Year Ending June 30, 1951

The main purpose of this report is to provide an opportunity for presenting in published form recent results from experimentation in fields or on projects where progress has not been such as to justify the general and definite conclusions necessary to meet the requirements of bulletin or journal.

UNIVERSITY OF MASSACHUSETTS
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

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CONTENTS

ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION—1950-1951

DEPARTMENT OF AGRICULTURAL ECONOMICS AND FARM MANAGEMENT

A. H. Lindsey in Charge

Study of Farm Real Estate, Taxation Methods of Taxation Reform, and the Effect of Such Measures on Farm Income. (A. A. Brown and R. A. Fitzpatrick.) In Massachusetts, land accounts for 45 percent of the total real estate valuation of dairy farms, but marked variability exists in the productivity of the land in the farms. Land utilization, basically, is a function of soil type, and soil types differ among farms and parcels of land in the farm. Consequently, farms differ in their capacity to produce income. For tax purposes, however, a lump sum is placed on all the land in the farm. Such procedure results in over-assessment of the least productive and under-assessment of the most productive land.

The matter of devising objective methods for evaluating farm land is one which is receiving considerable attention here and in other parts of the country. In Hampshire County, a classification of sample dairy farms has been initiated and will serve as the basis for computing a set of tax values. The hypothetical set of values will be compared with the asessors' uniform values in order to appraise the relative merits of the two systems.

Production Adjustments on Representative Massachusetts Farms. (Bradford D. Crossmon, H. Russell Shaw, and Elmar Jarvesoo.) Farm management case studies are being continued on 47 selected Massachusetts farms. Dairy and poultry farms and cranberry bog operations have received the most study to date. Periodical checkups indicate that most of the farms have already made considerable adjustments in line with their farm development plans. Increased cow numbers, higher production per cow, and more and better home-grown roughage are the most common changes.

The study of portable pipe irrigation on hay and pasture crops was continued during the summer of 1950. Inasmuch as irrigation on grassland is an expensive measure in Massachusetts, every farmer planning the installation of such a system should consider other alternatives, such as increased fertilization per acre and purchase of additional land, which appear to be cheaper ways of securing additional roughage over a period of years.

Fluid Milk Prices. (A. A. Brown, V. J. Pierce, and H. G. Spindler.) Analyses of supply areas and price relationships of major Northeast milk markets and secondary markets of Massachusetts have brought out certain facts and conclusions that appear valid at this time:

1. Price differences between markets, based on the location theory of pricing make possible the alignment of regulated prices on the basis of transfer costs.

2. The supply area should include two separate zones: (1) a fluid supply zone extending from the market area just far enough to fulfill the fluid demands from the nearest available supplies, and (2) the most distant cream powder zones. For the Northeast, transportation costs can be minimized by using the nearest supplies for fluid purposes, thereby permitting lower prices to consumers and higher prices to producers.

3. The differences in prices between markets accounted for by transportation costs are relatively small. The farm supply prices are lower but appear to vary more than market prices.

Marketing of Hatching Eggs. (A. A. Brown and R. W. Brundage.) A report based on the experience of 81 broiler-hatching egg producers entitled "Broiler Hatching Egg Marketing by Massachusetts Poultrymen — The 1949 Season" was issued in February 1951. Of the many problems faced by these producers, the most important was the irregularity of marketing. Over-supply and then under-supply resulted because of the failure or inability of broiler processors and growers to anticipate the demand for broiler meat. These shifts appear to be reflected in the changing demand for broiler-hatching eggs. Integrated systems in which the processor or the feed man fills the critical role have been developed in an attempt to cope with the "boom or bust" characteristics of the industry. In either instance, control of marketings may extend from the processing plant through the hatchery to the breeder. The solution, however, has its disadvantages.

Marketing Massachusetts Potatoes. (R. A. Fitzpatrick and A. A. Brown.) The main barrier in potato marketing has been the justifiable reluctance of growers to publicize details of their business. The nature of potato marketing in this State is perhaps best demonstrated by 26 growers who used 20 different outlets to sell their 1950 crop. Three acreage groups have been drawn up for this report: 1 to 6, 8 to 13, and 25 to 100 acres. Each acreage group had distinctive marketing practices, but some methods were common to all. Direct selling was the rule with growers of the smallest acreages, who sold to local or nearby outlets, such as retail stores and their own farm stand, or peddled direct to consumers. In the 8- to 13-acreage group, direct selling was also important, but some different and larger outlets, such as hotels and restaurants, institutions, potato chip manufacturers, peddling, and city wholesalers, were used in addition to retail stores; the hauls were also somewhat longer. The 25- to 100-acreage group used 13 different outlets: country shippers, sales for price support, chip manufacturers, retail stores, chain store buyers, city wholesalers, and institutions. Direct selling was important, and long hauls (seldom over 150 miles) were common.

Storage operations were an essential feature of the marketing practices of the large growers. The principal variety was Katahdin, and late production accounted for over 80 percent of the total reported. Fifty percent of the 1950 crop was sold by December 1, including almost

all the early crop and part of the late. Of the potatoes stored beyond December 1, the largest volume was marketed during December, January, and February. Some stocks remained in storage until May.

Pricing Eggs on the Boston Market. (A. A. Brown, R. W. Brundage, and Alden Manchester.) The inadequacies of the system of pricing "nearby" eggs in Boston are brought out in the current study. In 1950, receipts of nearby (New England) eggs at Boston amounted to 14 percent of the receipts of the total production in the area, and only 12 percent were reported as sales by the Boston Herald. Slightly less than 2 percent of the quantity produced in the area served, therefore, as the basis for pricing.

In addition to the relatively small basis available for pricing purposes, no report was made on 16 market days. Moreover, the report showed no information available on four days and indicated three days on which only bids and offers were reported.

Prices for "nearby" eggs at Boston were closely related to those paid for brown eggs of comparable size and quality at New York City. The relationship was somewhat erratic on a day to day basis, indicating shortcomings in market information or possible inadequacies in the buying and selling arrangements between the two markets. Seasonally, however, prices in the two markets revealed a consistency with this qualification that when New England supplies were short to ample (January to July), Boston exceeded New York by 1½ to 2 cents, but when New England supplies were abundant (September to December), the New York margin over Boston was three to four cents. The variation in spreads was due to differences in grading practice in the two markets. Extra large were sorted from large in Boston; in New York these two sizes were not separated. The New York market has a very marked influence on price-making in Boston. The shortcomings of the New York market, however, as well as its good points, extend outward.

Better price-making in Boston is dependent, in the first instance, on improved market statistics. The data need to be related to present market organization and marketing arrangements.

DEPARTMENT OF AGRICULTURAL ENGINEERING

H. N. Stapleton in Charge

Investigations on Mechanizing Cranberry Production. (Earle F. Cox and F. B. Chandler.) A hydraulic sanding mechanism has been designed to replace wheelbarrow and hand labor for distributing sand on the cranberry bogs. With this mechanism, sand is introduced into an open jet which discharges into a Venturi section from which a mixture of sand and water (20 percent by volume) is carried through 340 feet of plastic pipe (3-inch inside diameter) out to the particular cranberry section to be sanded. After the sand is deposited, the water returns through the present drainage ditches. Operation has been successful with a pressure of 100 pounds per square inch at the jet.

A laboratory apparatus has been designed for testing spray nozzles. Tests have been run to determine the particle size and distribution of particle size from various nozzles. When a satisfactory nozzle is found, it will be used with the sprayer developed for the Allis Chalmers Model G tractor modified for use on cranberry bogs, mentioned in last year's report.

Cranberry Harvesting and Packaging Investigations. (Earle F. Cox and F. B. Chandler.) Bulk storage of cranberries has been investigated during the past year. Berries were placed in bins to a depth of 5 feet and stored wet or dry; a curing fan was employed. The keeping quality of berries at various levels within the bin differed very little; the berries stored dry kept better than those stored wet.

At the time of harvest, the following practices were investigated: leaving berries out overnight to cool, refrigerating for one to three days, fan cooling, hand and machine separating. After the tests, all berries were stored in the same screen house. Berries that were least disturbed during post-harvest handling kept best.

Tests were also conducted to determine (1) what percentage of berries saved by the separating machine could be obtained from the first two bounce boards and (2) the keeping quality of berries from the various bounce boards. Almost 75 percent of the sound berries were obtained from the first two bounce boards; moreover, these berries were far superior in keeping quality than berries from the third and fourth bounce boards. Results indicated that sufficient berries could be obtained from the first two bounce boards to supply the fresh fruit market.

Investigations to Improve Tobacco Curing. (H. N. Stapleton and Earle F. Cox.) This project has been a cooperative one with tobacco farmers. In two barns, installations were made with no auxiliary heat provided. Fans were run continuously, and a damper was provided to exhaust air or recirculate air. A good cure was reported in all parts of the barn although the cure did not seem superior to that in other barns where no fan was used. In the second barn, serious spoilage was reported in the second tier of tobacco. The two top tiers were well cured.

In a third barn where only natural air was employed, a good cure was reported. The fan was run almost continuously on recirculation, and the barn doors were never opened during the curing season.

A fourth barn had an indirect fired oil burner with a rated capacity of 8.9 gallons per hour. The burner was used for a short period; then fans to provide recirculation or exhausting of air completed the cure, and the burner, in the meantime, was started in a second barn. Foreign material in the nozzle reduced oil burner capacity to 5 gallons per hour in the first shed, where the third tier of tobacco was partially spoiled, and the fourth tier completely spoiled. In the second shed, the burner capacity was increased to 7 gallons per hour by cleaning the nozzle. Here, the cure was satisfactory even though the outside temperature was lower than the temperature during the time the tobacco in the first shed was being cured.

A Foxboro 24-point instrument recorded dry bulb, leaf, and dew point temperatures at each of eight different points within the shed. The leaf

temperatures were almost the same as the dry bulb temperature, but there was no consistency in their relationships.

A Foxboro 6-point instrument recorded dry bulb temperature in a second shed at six different points. The temperature varied as much as 15 degrees. Heat was introduced at one central point, and fans recirculated or exhausted air. Temperatures could be maintained very uniform throughout the shed when heat was not being run.

Improvement of Poultry House Ventilation. (H. N. Stapleton and Earle F. Cox.) An automatic system of ventilation was installed and used from February 1 until the end of the season. This system was used with a damper motor to give continuous exhausting of air from the house above a set thermostat temperature. Below this thermostat temperature the air was exhausted a set amount during a 10-minute cycle. For this test the set amount was 2 minutes during the 10-minute cycle. The system was satisfactory in performance. As a check against the automatic system, other exhaust fans were run intermittently according to the operator's judgment. This was not as satisfactory as the automatic system.

DEPARTMENT OF AGRONOMY

W. G. Colby in Charge

Preparation of Tobacco Seedbed Soil. (C. V. Kightlinger.) Several recommendations may be made to improve the methods of preparing tobacco seedbeds:

1. Old seedbeds should be destroyed as soon as possible after tobacco has been transplanted and restocked.

2. Frequent harrowing of the soil and early disposal of unused plants by killing with formaldehyde or by hoeing out before the seedbed is plowed and harrowed will reduce the supply of possible disease-causing inoculum.

3. The soil should be harrowed frequently throughout the summer.

4. In the fall the soil should be worked well, the seedbeds shaped, the soil fertilized and sterilized in this order.

5. Any sterilization method that is effective may be used. With steam sterilization, it is preferable to treat the soil in the fall because it may be difficult in the spring to keep the soil moistened sufficiently for plants to grow well. With chloropicrin or methyl bromide sterilization, the soil should be treated in the fall while its temperature is 60°F or higher, otherwise poor sterilization will result.

6. Soil should be well leveled and smoothed before seeding. If prepared for seeding in the spring, it should be worked to a depth of not more than 3 to 4 inches to keep unsterilized soil and viable weed seed from coming to the surface of the seedbed. Soil capillarity is more quickly re-established in this way than it would be with deeper cultivation because it prevents the formation of deep pockets or surface hollows.

New Uses for an Old but Little Known Grass — Field Brome. (William G. Colby and Mack Drake.) The need on vegetable land for a cover crop that does not become a weed hazard by reseeding itself if sown in late summer or early fall has focused attention on a winter annual similar to winter wheat or winter rye — Field Brome Grass (*Bromus Arvensis*). When seeded September 1, 1949, it produced 2600 pounds of roots (dry weight) per acre, whereas winter rye produced 1440 pounds. Nutritious and palatable, when fertilized adequately, it can be used for pasturing all types of livestock, including poultry, in late fall until freezing weather sets in. Heavy grazing or ranging will not seriously injure the sod.

In addition to producing forage in late fall and early spring, field brome is a very successful smother crop for many undesirable grasses, such as Kentucky blue grass, red top, bent grass, and witch or quack grass — a feature that makes it extremely useful in grassland systems of farming where intertilled crops are not included in the rotation.

This grass is a heavy consumer of nitrogen. Plantings in 1950 made on an old heavy bluegrass sod were fertilized with 1000 pounds per acre of a 5-10-10 fertilizer. Two top-dressings of ammonium nitrate were made during the fall and one before grazing started in the spring. About 40 pounds of elemental nitrogen were applied each time. As a cover crop, Field Brome should have supplemental nitrogen added, not only for growth but also for facilitating the breakdown of tough, heavy sod at plowing time.

Farm Fish Ponds. (Karol J. Kucinski.) An experimental fish pond was built in the valley of an orchard watershed of about 60 acres drainage to determine whether the powerful insecticides and fungicides that drain from the orchard would have any poisonous effects on fish in the farm fish pond. It was found that the toxic chemicals are rendered harmless or are immobilized by the soil colloids where they are applied and do not reach the pond waters in their original harmful state.

Evaluation of Additions of Sodium Nitrate and Ammonium Sulphate Applied in Late Summer Preceding Spring Planting of Tobacco. (Walter S. Eisenmenger and Karol J. Kucinski.) It has been a common experience for tobacco growers to obtain an inferior tobacco crop where they have plowed under sods of grasses, clover, or fields of corn stubble and then planted tobacco. This inferior crop may be due to excessive slowly decomposing fibrous tissue, or possibly such crops may invite nematodes during their growing period because nematodes seem to prefer grasses as their hosts. When much lignin is present, and plants are grown on the area, application of nitrogen overcomes, to a degree, the difficulty of malnutrition for the succeeding crop. Tests have indicated that it would be desirable to apply 50-100 pounds of nitrogen per acre when plowing under grass sod in the early spring if the land is to be used for tobacco.

Irrigation Studies and Management of Irrigated Soils. (Karol J. Kucinski.) Although the idea of irrigation is not new in this State, since there has been a limited use of permanent overhead irrigation on small intensively cultivated areas for many years, much interest has been

shown recently in supplemental irrigation for a wide variety of crops. Especially is this true during drought seasons. Part of this newly aroused interest has resulted from the advent of lightweight, quick-coupling pipe using revolving sprinklers or perforations that are adaptable even on rolling ground.

It is felt that in many cases the increase in crop yields, the insurance against crop failures, and improvement in quality of the product will more than justify the original cost of installation and subsequent maintenance. However, there is need for much more information concerning the proper soil and crop management practices where supplemental irrigation is employed and also on various engineering phases of the problem.

DEPARTMENT OF ANIMAL HUSBANDRY

Victor A. Rice in Charge

A Study of the Mineral Elements of Cows' Milk. (J. G. Archibald.) The work with molybdenum has been completed. A manuscript entitled "Molybdenum in Cows' Milk" has been submitted for publication in the Journal of Dairy Science. The following is quoted from the summary of that paper:

"Molybdenum appears to be a natural constituent of cows' milk, the amount varying in different breeds and individuals but of the general order of 40 to 70 micrograms per liter of whole milk.

Feeding 500 micrograms daily of ammonium molybdate to eight cows for periods of two months increased the average amount of molybdenum in their milk about fivefold.

The level of molybdenum in these milks was higher than that of manganese and much higher than the level of cobalt. The response to feeding a supplement of the element, as indicated by increased levels in the milk, was greater than for any other trace element studied thus far.

Milk samples from control cows milked directly into glass showed levels of molybdenum similar to those obtained via the milking machine, thus eliminating the possibility that any of the molybdenum in these control milks was due to metallic contamination.

Analysis of composite samples of cream and skim milk showed that most of the molybdenum in 'control' milks or in those from cows receiving a molybdenum supplement was concentrated in the cream fraction."

A Study of Quality in Roughage: Composition, Palatability, and Nutritive Value of Hays as Affected by Curing, Harvesting, and Storing Procedures. (J. G. Archibald, M. L. Blaisdell, E. Cox, and H. N. Stapleton.) Studies of the chemical composition of a large number of hays grown on the University farm and on farms in different parts of the state reveal that:

The weather during the growing season did not have any substantial effect on the composition of grass at cutting time.

The principal loss during the curing of hay was in carotene; exposure to bright sunlight was more destructive of carotene than was a moderate

amount of rain. Protein was substantially unaffected by the curing process regardless of weather.

Hays in which the curing process was completed by barn-drying were significantly higher in carotene at time of storage than were those completely cured in the field, but this advantage had disappeared almost entirely by the time the hays were fed out.

Changes in composition during storage were considerably greater than those which took place in the field after cutting. Most of these changes took place in the first month of storage, a large part of them during the first week.

Losses of nitrogen-free extract, sugar, and carotene during storage were closely related to moisture content of the hay at time of storage.

Feeding trials for milk production with barn-cured and field-cured hay gave identical results.

It is our opinion that the advantages of barn-curing of hay are to be found in shortening of the hay-making operation and in saving hay from spoilage by weathering rather than in greater nutritive value of the product as fed out.

Barn-drying is a useful adjunct in any system of storing forage, but one should not expect miracles from it. Good hay can be spoiled very easily by improper or inadequate drier installations.

In view of the losses of carotene in storage regardless of method of drying, it is recommended that farmers assure the carotene supply for their animals by storing as much as possible of their first cutting hay in the form of grass silage.

DEPARTMENT OF BACTERIOLOGY

Ralph L. France in Charge

Differential Studies of Pseudomonas Species. (James E. Fuller and Robert E. Canning.) This study was undertaken cooperatively with the Mastitis Laboratory to obtain information that would aid in the detection and identification of strains of the genus *Pseudomonas* that are found in the testing of dairy herds for mastitis. The study included two phases: (1) an investigation of media for detection and (2) a study of the water-soluble pigments produced by the organisms as a possible basis for species identification. Colonies appearing on blood-agar plates could be verified as *Pseudomonas* species by pigment production when transferred to a medium containing asparagine, dipotassium phosphate, and magnesium sulfate. Koser's sodium-citrate medium was also usable, but less satisfactory than the asparagine medium. Standard differential tests indicated that all the cultures studied were *Pseudomonas aeruginosa,* but the use of pigment production as a basis for quick identification was not dependable.

Studies on Plate Counts of Bacteria. (James E. Fuller and William C. Squires.) The clumping of bacteria has always been a problem in making plate counts of bacteria because different clumps contain widely varying numbers of bacteria, yet each clump is likely to produce only one countable colony on a plate. An effort was made to break up bac-

terial clumps by reduction of surface tension with surface-active agents and fatty substances, and by mechanical separation of clumps with high-speed mixing procedures. None of these methods was effective because the separated bacteria exhibited a definite tendency to reclump rapidly, which indicated the probability that clumping is a natural phase of bacterial behavior for the mutual benefit derived from close association of cells of a species. If this is true, the effort to break up clumps does not appear to be logical.

Bacteriological Study of Sour Cream Made by the Supplee Method. (James E. Fuller and Robert W. Bibeau.) This study was made in co-operation with the Department of Dairy Industry of the University to obtain information regarding the necessity for agitation during the souring period and the survival of bacteria introduced into the cream during agitation. Results indicated that agitation was not necessary but could be objectionable because of the possibility of introducing contaminating bacteria during the process. Seven species of commonly-occurring bacteria that might easily gain entrance to the souring cream were found not only to survive but to multiply in the product. Bacteriological examination of some commercially-soured cream samples indicated that care and cleanliness had been exercised in their preparation.

Bacteriological Studies with Hens' Eggs. (James E. Fuller and Walter C. Flanders.) This study was made to secure information desired by the Department of Poultry Husbandry. The first part of the study concerned the isolation and identification of bacteria from the surface of eggs from a disease-free flock of hens. These organisms included fecal and skin flora and those species common to dust and soil. No pathogenic bacteria were found. The egg contents were nearly free from bacteria of any type. Experiments were carried on to investigate the penetration into the egg contents by the bacteria occurring naturally on the shells. There was little penetration into eggs stored dry, even at room temperature. Eggs tested were in three categories: not cleaned, washed, and sanded. When eggs were placed in sterile nutrient broth and stored at room temperature, the bacteria present on the shells grew in the broth and readily penetrated through the shell into the egg contents. Washing the eggs to clean them increased shell porosity and facilitated the penetration by bacteria; sanding permitted an even greater penetration by bacteria. A quaternary ammonium solution, 200 parts per million concentration, employed to wash one lot of eggs was effective in preserving the sterility of the egg contents. This procedure would not be legal now, but it is worthy of further investigation, and it should be possible to overcome objections so that legal restrictions could be removed.

Bactericidal Action of Ozone. (John M. Dickerman and Arthur O. Castraberti.) Ozone has been employed on a considerable scale in Europe and South America as a sterilizing agent for municipal water supplies. The method has not found favor in the United States because the equipment has been unwieldy and expensive to operate. Recently improved equipment that can be operated more economically has been developed;

an investigation of the bactericidal efficiency of ozone was then undertaken. The main objective was the destruction of microbic life in water. Secondary objectives were the removal of tastes, odors, color, and organic material. An ozone residual of 1 to 2 parts per million was found to be effective against microbic life in the absence of organic matter in the water. When organic matter is present, it combines with and inactivates ozone, requiring a greater ozone residual. Ozone was found to be more effective than chlorine for the sterilization of water, when the two were compared in equal concentrations.

An Antibacterial Substance in Cabbage Extract. (John M. Dickerman and Samuel Liberman.) A study was made of a number of vegetable juices to determine the possible presence of substances that would be antagonistic to bacterial growth. One such substance, found in aqueous extracts of Danish Ball Head cabbage, inhibited the growth of groups of pyogenic, intestinal, and sporulating types of bacteria. A study of the chemical structure of the substance, by means of paper-chromatographic procedure, indicated that it had strong reducing properties and was probably carbohydrate in nature.

DEPARTMENT OF BOTANY

Theodore T. Kozlowski in Charge

Determination of Fungous and Bacterial Pathogens in Commercial Propagating Stock of Carnations. (R. W. Ames.) Culturing of carnation cuttings to secure disease-free stock has been practiced in commercial concerns with apparently satisfactory results. Studies were made to determine the actual value of such a technique in detecting and eliminating infection and to compare the advantage of this method in culturing with that of the current practical method of careful selection and sound cultural practice.

The presence or absence of Fusarium was determined in 100 cuttings from apparently healthy plants of two varieties, Northland and Virginia Hercules. In Northland, the percentage of cuttings infected varied from 2.5 to 18.0, whereas in Virginia Hercules the percentage varied from 5.3 to 11.2. Suitable plots of rooted plants of both cultured and uncultured cuttings will be grown for flowering to determine the feasibility and practicability of this technique.

Improved Methods of Control of Clubroot of Crucifers and Other Soilborne Diseases of Plants. (W. L. Doran.) Growth of cabbage plants was improved by the addition of ground limestone with mercurous chloride to soils both infested and uninfested with *Plasmodiophora brassicae*, but growth of plants in infested soils showed greater improvement. All applications of mercurous chloride to the soil were made through commercial fertilizers as carriers. Effects of ground limestone and mercurous chloride on clubroot and growth of plants in 11 different soils inoculated with *Plasmodiophora brassicae* are being compared.

Technical chlorobromopropene (25 percent by weight, active) 0.5 gm. per square foot of soil controlled damping-off of beet, cabbage, and tomato seedlings but did not control clubroot. Vancide 51 controlled damping-off of beet, cucumber, and lettuce seedlings at the rate of 0.6 cc. per square foot immediately after seeding.

Tomato Leaf Mold Caused by the Fungus Cladosporium fulvum Cke. (E. F. Guba.) Since the previous report, two further generations of our three new hybrid red tomatoes have been selected for resistance to *Cladosporium* and desirable fruiting type, and effort has been directed towards producing types with larger fruit than Improved Bay State. The No. 4 tomato has much larger fruit than Improved Bay State, and growers regard it favorably. Hybrids Nos. 2 and 3 are immune to *Cladosporium*, deriving this immunity from *Lycopersicon peruvianum* (L.) Mill. These are still being selected for further improvement and have been crossed with improved Bay State in an effort to combine immunity to all forms of leaf mold with desirable commercial type.

Introductions of our leaf mold resistant tomatoes have contributed to significant savings and increased earnings to growers. Tucker (Missouri) combined resistance to *Cladosporium* in Improved Bay State with resistance to Fusarium wilt. Budzien (Wisconsin) has developed a pink tomato for Milwaukee with resistance to *Cladosporium* derived from Improved Bay State.

Effect of Fluorescent Sun Lamp on Plants. (L. H. Jones and E. A. Snow.) At a distance of 30 inches and under continuous illumination, various plants were severely injured by the rays of a 20-watt fluorescent, ultraviolet light bulb. Temperatures of the soil and air under the bulb were not raised by the cold light. When window glass or celluloid was inserted between the light and the plants, no injury resulted; however, quartz glass allowed the lethal rays to pass through.

Damping-off and Growth of Seedlings and Cuttings of Woody Plants as Affected by Soil Treatments and Modifications of Environment. (W. L. Doran.) Work was continued on the best methods of using fungicides, especially Phygon XL (50 percent 2,3-dichloro-1,4-naphthoquinone) quinone) in the treatment of cuttings. The fungicide was applied to cuttings by either the powder-dip or the solution-immersion method. In some cases, such treatments of cuttings with fungicides were used in combination with root-inducing substances. In other cases, the treatments were used alone.

Phygon XL is giving better results with cuttings of most species than other fungicides similarly used. Phygon XL, 0.3 gm. per liter for 24 hours, used with indolebutyric acid in solution, improved rooting of softwood cuttings of *Cornus florida*, *Clethra barbinervis*, and *Rhododendron calendulaceum*, and rooting of leaf-bud cuttings of *Rhododendron catawbiense* more than did indolebutyric acid used alone.

Phygon XL, used in this way, also improved the rooting of cuttings of *Rhododendron catawbiense* when no indolebutyric acid was applied.

Rooting of fall and winter cuttings of conifers (an arborvitae, a juniper, and a fir) was more improved by powder-dip treatment with Phygon XL, Phygon XL (talc 1:1 and Phygon XL), Hormodin No. 3 (1:2) used with indolebutyric acid or a-naphthaleneacetic acid than by the root-inducing substances used alone and applied by the solution-immersion method.

It was found that cuttings of *Tsuga canadensis* rooted in larger percentages if made from wood in its first year than if made from wood in its second year. Percentages of cuttings that rooted were markedly increased by treatment of cuttings with indolebutyric acid and with a-naphthaleneacetic acid. Cuttings of hemlock were successfully taken from many trees between mid-August and late January. Percentages of cuttings of hemlock that rooted were increased by their powder-dip treatment with Phygon XL alone or variously diluted, such treatments supplementing solution-immersion treatments with root inducing substances.

Investigations of Fungicides That Promise Value in Apple Disease Control. (E. F. Guba.) Weather conditions at Waltham in 1950 were unfavorable for apple scab. The rainfall for April was 2.29; May, 1.31; June, 1.43; July, 1.53; August, 4.55; and September, 1.67 inches; with the total rainfall for the period being considerably below normal. To compare the effect of post-infection applications of fungicides on scab control, the following materials were tested: Koppers Flotation Sulfur Paste, 12 lb.; Phygon XL and Epsom Salt, ½ and ¼ lbs.; Puratized Agricultural Spray, 1 pint; and Puratized Apple Spray, 1 pint. Applications were as follows: Prepink, May 5[1]; Pink, May 12[1]; Calyx, May 22[1]; 1st Cover, May 29[2]; 2d Cover, June 2[3]; 3d Cover, June 7[2]; 4th Cover, June 16[2]; 5th Cover, July 7[2].

Insecticide (DDT and lead arsenate) with Phygon-Epsom Salt caused 9 to 10 percent russetted Delicious apples; insecticide with Flotation Sulfur Paste, 5 to 8 percent; insecticide with phenylmercuri fungicides (Puratized Agricultural Spray and Puratized Apple Spray), none. More or less Phygon foliage chlorosis was noted on McIntosh, Delicious, and Baldwin foliage. Kolofog and Phygon combined (3 lb. and ¼ lb. did not produce apparent foliage chlorosis. Yellow foliage and defoliation occurred on unirrigated Baldwin and Delicious trees sprayed with phenylmercuri fungicides.

Irrigation greatly increased fruit weight and volume. Stippen or Baldwin spot was most prevalent at harvest in fruit from irrigated trees but did not increase after four months of storage.

Combining foliage chemical nutrients with insecticides and fungicides in the spray tank is being commercially practiced. In cooperation with W. D. Weeks and W. D. Whitcomb, comparisons are being made of mixtures containing sulfur, ferbam, lead arsenate, DDT 50 percent wettable, NuGreen, Epsom Salt, Borax, TEPP and Dimite on McIntosh, Rhode Island Greening, Delicious, and Northern Spy. Mixtures without sulfur or ferbam are not fungicidal according to laboratory studies.

1 Fungicide only. 2 Insecticide only. 3 Insecticide and Fungicide. Insecticide used was lead arsenate 2 lb., 50 percent DDT wettable 2 lb. to 100 gallons of water.

Resistance to *Fusarium dianthi*, the Cause of a Serious Carnation Wilt Disease. (E. F. Guba.) Since the previous report, numerous seedlings of selfs of John Briry and Eleanor and crosses of these two commercial varieties are being grown. Cuttings are being propagated and inoculated with Fusarium to identify susceptible lines. Susceptibility and immunity have appeared, and it is still too early to appraise commercial possibilities. It is planned to self the seedlings showing resistance to the Fusarium fungus, to repeat the routine of growing, propagating, and inoculating until pure lines for resistance have been obtained, and to backcross resistant seedlings to resistant parents in an effort to combine resistance with desirable commercial type.

Three of the investigator's earlier seedlings (Regal Pink, Waltham Pink, and Mrs. E. F. Guba) released to the trade are resistant to Fusarium wilt and are being widely disseminated. Mrs. E. F. Guba, the most unusual and outstanding of the three varieties, received an Award of Merit at the 1950 New England Carnation Growers Variety Day at Tewksbury, Massachusetts. It scored 90 points, the highest of any variety, at the New York Florists' Club Carnation Night in February, 1951. It also won a Certificate of Merit and scored 91 points at the American Carnation Society exhibition in Dayton, Ohio, in March, 1951, and missed the "Best Variety in the Show" by one point.

Top Soil Applications of Chemicals for the Control of Carnation Wilt Diseases. (E. F. Guba and R. W. Ames.) Chemicals showing promise as soil disinfestants in fundamental laboratory pilot tests were applied to soil in a mixture with sand at regular intervals. Rhizoctonia stem rot control, plant tolerance, and yield were considered in evaluating treatments.

Preference was shown in every respect by New Improved Ceresan 0.78 oz., Fermate 3.10 oz., and Semesan 3.10 oz. per 100 sq. ft. of growing bed, per application. Loss from stem rot in beds not treated with chemicals was much greater; for example, a 20.3 percent loss was reduced to 3.6 percent by New Improved Ceresan; 4.2 percent by Fermate and 5.7 percent by Semesan. However, in practice this loss can be largely avoided by shallow planting and sound cultural practices. Phenylmercuri acetate in a dilution twice that recommended for plant protectant spraying, 1 pint per square foot, at monthly intervals also gave some control of Rhizoctonia stem rot. In other tests no control of Fusarium and Phytomonas wilts (both systemic diseases) could be shown by chemical soil treatments.

In general, soil application of fungicides in beds planted to carnations as a method of controlling the systemic wilt diseases is not considered advisable; growers have been benefited measurably by heeding this advice. The general failure to control wilt diseases by soil applications of chemicals has encouraged growers to consider judicious selection of propagating stock, laboratory culture of cuttings to eliminate infection, and soil steaming.

Tobacco Frenching. (L. H. Jones.) Previous work in this laboratory has made it possible to induce frenching of tobacco at will. The two most important conditions are the presence of the frenching factor in the soil and relatively high soil temperature. No symptoms of frenching have ever appeared when the soil temperature was 70°F. or lower. Lowering a soil temperature from 95°F. to 70°F. causes each new

leaf on a frenched plant to appear less frenched to the point where normal leaves are developed. Tomato (John Baer) and the smooth-leaved tobacco, *Nicotiana glauca* Graham, developed abnormalities when exposed to the frenching factor at a high soil temperature. Pepper (California Wonder) which is in the same family as tobacco and tomato, has not shown any susceptibility to the frenching factor.

Although the exact nature of the cause of frenching is not known, evidence points to a soil-borne organism which under conditions of high soil temperature affects some basic nutrient supply or creates a toxin that is absorbed by the plant. This frenching factor has been recently found in soils on which tobacco has probably never been grown. It is the opinion of this investigator that the frenching factor will be found, in particular, in soils that are quite moist even in protracted drought periods. Samples used during the past year have given 100 percent positive tests to support this opinion. By increasing the amounts of applied hydrated lime to a soil with an original pH of 5.5, the acidity of the soil was decreased to a pH of 7.4. Plants at a soil temperature of 95°F. within this range of pH values frenched earlier, and symptoms were more intense where lime was applied. However, with larger amounts of lime and an increase in pH, there was a slight lag at pH 7.9. It took 46 days for frenching to appear at a pH of 8.07, but only an average of 16 days to appear in the non-limed soil. Further increase in the amount of lime raised the pH value to 8.32, and during the 75-day period of this experiment no frenching symptoms appeared.

Histology of Frenched Tobacco Leaves. (L. H. Jones, E. C. Putala, and L. H. Weinstein.) Very young leaves of tobacco from normal, moderately frenched, severely frenched, and nitrogen deficient plants were prepared to study tissues, cell size, and nucleus size. From this study the preliminary results indicate a marked change not only in the gross morphology of leaves in a frenched plant but also in the cells and tissues of the leaf.

Availability of Soil Moisture for Active Absorption in Drying Soil. (T. T. Kozlowski and T. J. Army.) Whether or not water is equally available to plants in drying soil from field capacity to wilting percentage has not yet been confirmed. Two New England soils of varying textural grade, Merrimac Fine Sandy Loam and Suffield Silt, were used in an investigation to study the effect of soil moisture content on active absorption as measured by exudation from detopped plants. Experiments were performed on tomato (*Lycopersicon esculentum* Mill.), tobacco (*Nicotiana tabacum* L.), corn (*Zea may* L. var. *identata*), and bean (*Phaseolus vulgaris* L.).

A total of approximately 60 percent of soil moisture in the range from wilting percentage to moisture equivalent appeared to be a minimum value which was not available for active absorption. Further evidence indicated that much greater forces for water intake are developed in tops of plants than in their roots.

Effects of Mineral Deficiencies on Active Absorption by Plants. (T. T. Kozlowski and A. J. Poivan.) This investigation was undertaken to determine effects of mineral deficiencies on active water absorption as shown by diurnal fluctuations in exudation from detopped plants and thereby to ascertain whether a direct relation exists between metabolism and active absorption.

All treated plants showed a diurnal variation in exudation rate, but this was least apparent for nitrogen-deficient and distilled water treatments. Total exudation for the duration of the experiment was greatest for the minus iron treatment, followed by complete solution, minus magnesium, minus phosphorus, distilled water, and minus nitrogen treatments. In plants grown in solutions lacking nitrogen and in the distilled water treatment, duration of exudation was short, complete cessation occurring two days after excision. The erratic variation and short duration of exudation cannot be attributed to differences in size of root systems. These effects appear to be attributable to varying metabolic rates conditioned by specific mineral deficiencies on active absorption by roots.

DEPARTMENT OF CHEMISTRY
Walter S. Ritchie in Charge

Investigation of Agricultural Waste Products. II. The Chemical Composition of Certain Wild Plants, with Special Reference to the Content of Alpha Cellulose, Polyuronides, Gums, and Soluble Sugars. (Emmett Bennett.) The plant kingdom is a storehouse of many chemical compounds present in varying amounts. Some may constitute approximately 50 percent of the dry matter of plants. This group, the structural carbohydrates in farm crops, has tremendous possibilities, but at present is of little economic importance. Depending upon its chemical composition, the same crop could be grown for industrial as well as for food purposes. An outlet for fibrous crops, damaged or otherwise, would be a decided economic advantage. With this in mind, approximately 30 economically unimportant plants have been analyzed for the content of total cellulose, alpha cellulose, furfural, and total soluble sugars. The results on a dry matter basis are as follows:

1. The content of cellulose ranged from approximately 20 to 50 percent; about one-third of the samples contained from 40 to 50 percent.

2. Approximately 60 to 70 percent of the total cellulose could be clarified as alpha cellulose. Twenty percent of the plants contained cellulose that consisted of over 70 percent alpha cellulose. The common smartweed, butterweed, and aster contained the highest percentage of this fraction.

3. The content of furfural varied from about 3 to 15 percent; about 25 percent of the plants contained over 10 percent. Poverty grass, jimson weed, butterweed, and witchgrass contained the highest percentage.

4. Soluble sugars ranged from about 3 to 15 percent; about 15 percent of the plants yielded over 10 percent. The stalks of the common milkweed, wild lettuce, members of the dock family, and the sedge plant contained the highest percentage.

Relative Availability of Phosphorus Fertilizer Materials to Forage Crops. (Mack Drake, Chemistry, and W. G. Colby, Agronomy.) Phosphorus is widely recognized as an essential element for plant and animal development. The long-lived legumes, alfalfa, and clover, valued for their high mineral and protein content, often fail because of inadequate supplies of available phosphorus in the soil. Desirable grasses such as smooth brome and orchard grass, which are grown in association with the legumes, remove large quantities of phosphorus. As contrasted to annual crops, these slower growing, longer lived perennial forage crops may remain on a given soil for 4 or 5 years. Thus the total amount of phosphorus required for 4 or 5 years of forage is large. If this total is supplied at planting in a soluble or available form as superphosphate, a large amount of the available phosphorus will become "fixed" as relatively insoluble (low availability) phosphates of iron and aluminum in the soil. On many soils the annual application of superphosphate as a top dressing may not be efficient. Furthermore the "world sulfur shortage" and increased demand for available phosphate fertilizers have reduced and will continue to reduce the supply of cheap available phosphorus for perennial forage crops in New England. Thus an efficient method for the use of large applications of slowly available phosphorus before planting is highly desirable. It is reasonable that for long lived, slower growing plants, such as the perennial forage crops, a form of phosphate such as finely ground raw rock phosphate that is less soluble, more slowly available, might be equal to or higher in over-all efficiency than the highly available, soluble forms such as superphosphate.

The present information on relative availability of phosphorus from finely ground raw rock phosphate and superphosphate (20 percent P_2O_5) for forage crops is inadequate. Although superphosphate and rock phosphate have been compared in many field experiments, in many cases the treatments did not supply adequate quantities of nitrogen or potassium, or did not supply comparable amounts of sulfur.

A field experiment was laid out near Amherst in 1949 on a Merrimac fine sandy loam low in fertility. Alfalfa, timothy, and a ladino-smooth-brome grass combination were seeded across phosphate treatments. Three rates of finely ground raw rock phosphate (2000, 3000, and 4000 pounds per acre) were compared with two rates of 20 percent P_2O_5 superphosphate. (1000 and 2000 pounds per acre). The combination treatment of 1000 pounds rock phosphate (with 50 pounds of sulfur) plus 500 pounds of superphosphate was included. Three rates of sulfur (0, 100, and 456 pounds per acre) were used with the 2000-pound rate of rock phosphate. Rock phosphate and sulfur were broadcast and disked into the surface 3 to 4 inches of soil. Pelleted superphosphate was applied in bands (7 inches apart and 3 inches deep) to minimize fixation. The yields from rock phosphate were expected to be relatively lower the first year; however, in 1949 the year of seeding was so dry that no yields were taken. By the second year when the first yields were taken, both rock and superphosphate supplied adequate phosphorus for plant growth. Phosphorus availability from the rock might not have compared so favorable in the first year. In 1951, two additional experiments of this type were laid out to check this and other points.

Results of the first harvest year, 1950, and the first cutting in 1951 were:

1. Ladino-clover-smooth-brome grass yields on 2000 pounds rock phosphate plus 100 pounds sulfur were equal to the yields in 1950 and were 7 percent greater in 1951 than on 1000 pounds superphosphate.

2. Timothy yielded 4 percent less in 1950, but 15 percent more in 1951 on 2000 pounds rock phosphate plus 456 pounds sulfur as compared to 1000 pounds superphosphate.

3. Alfalfa yields from 2000 pounds of rock were equal to 1000 pounds superphosphate, and were 6 percent greater for 4000 pounds rock phosphate plus 100 pounds of sulfur than for 2000 pounds superphosphate.

4. Phosphorus content of the forage on the above results was comparable.

5. On this soil there is an advantage in using a combination of rock-phosphate-sulfur and superphosphate. The combination treatment 500 pounds of superphosphate plus 1000 pounds rock phosphate with 50 pounds sulfur has produced greater yields of alfalfa, timothy, and ladino-brome than 1000 pounds of superphosphate.

The Production of Holocellulose from Nonwoody Plant Tissue. (Emmett Bennett.) Holocellulose prepared for subsequent quantitative determination of hemicelluloses contained at least two fractions. As judged by the production of furfural, the first fraction may be removed so easily that it is a handicap in quantitative procedures. A final fraction seems to be relatively stable to alternate chlorinations and sulfite treatments. A significant quantitative procedure should exclude the final fraction, which may amount to 30 percent of the total furfural.

Influence of Processing, Distribution, and Storage on Loss of Ascorbic Acid in Milk. (Arthur D. Holmes.) It is unfortunate that milk, so important in the human diet, loses so much of its original 20 to 25 mg. of reduced ascorbic acid per liter during processing, distribution, and storage. Reduced ascorbic acid may be destroyed considerably during the commercial distribution of milk, particularly when it stands in sunshine or bright light for any length of time on the consumer's doorstep. Notwithstanding all ideal conditions during processing and distribution, serious losses may still occur when milk is stored in the home refrigerator.

Effect of Added Riboflavin on the Permanency of Ascorbic Acid in Raw Cow's Milk. (Arthur D. Holmes.) Cow's milk, which contains about 10 times as much riboflavin as mare's milk, will lose 80 percent of its ascorbic acid during six days' storage in a refrigerator, whereas mare's milk will lose about 8 percent. To determine whether a larger amount of riboflavin will influence the stability of ascorbic acid, pasteurized cow's milk was fortified with U.S.P. riboflavin at the rate of 4 mg. and 8 mg., respectively. Seventeen series of milk samples prepared at intervals between September and March were stored from Monday to Friday in darkness at 10°C. and assayed at 25-hour intervals. During the 96-hour storage the unfortified milk, the milk fortified with 4 mg. and 8 mg. of riboflavin per liter lost 77, 73, and 69 percent of their reduced ascorbic

acid, respectively, indicating little if any change in the amount or rate of destruction of reduced ascorbic acid during storage in glass containers in darkness at 10°C.

Reduced Ascorbic Acid Content of Milk at Different Stages of Processing. (Arthur D. Holmes.) Variation of reduced ascorbic acid in different bottles of milk from the same lot of pasteurized milk was studied. Between August 1 and May 1 four samples from each of 17 lots of milk processed by the Dairy Industry Department in commercial dairy equipment were taken: the first sample represented the thoroughly mixed cold milk before heating in the pasteurizing vat; the second sample, hot milk, was taken from the vat immediately after pasteurization; the third sample came from the first 20 quarts of milk passed through the cooling and bottling equipment; and the fourth sample was the last milk through that system. The raw milk contained 18.6 mg. of reduced ascorbic acid per liter; after pasteurization the milk contained 17.1 mg., retaining over 92 percent of its original ascorbic acid. The 17 samples of the first milk through the pipe lines supplying the surface cooler and the bottle filler averaged 5.9 mg. of reduced ascorbic acid per liter; hence, this milk had lost over 65 percent of the ascorbic acid present after pasteurization. The last milk through the system contained over 15.6 mg. of reduced ascorbic acid per liter, retaining over 91 percent of the reduced ascorbic acid present after pasteurization. The atmospheric oxygen with which the heated milk came in contact during its passage through the equipment and the contact of the milk itself with the processing equipment were probably responsible for the excessive loss of reduced ascorbic acid. These values indicate one cause of the wide variation in reduced ascorbic acid of commercial retail milk.

Changes in Vitamin Content Coincident with Different Stages and Rates of Maturity of Vegetables Used for Home Consumption. (Arthur D. Holmes.) The constant demand for additional information on cultural procedures for production of a profitable yield of tomatoes of high food value has initiated a study of the influence of mulching on the mineral content of tomatoes. Twelve plots were used: three mulched plots and one control plot with two replicates of each. The mulches (horse manure, rye straw, and shredded sugar cane stalks) were applied three inches deep. During the 89-day growing season there were 680 hours of bright sunshine and 12 inches of rainfall; the temperature ranged from 41° to 100°F. All plots received a 5-8-7 commercial fertilizer at the rate of 2000 pounds per acre. On a dry basis, typical tomatoes contained the following amounts per 100 g.: calcium — 203 mg., 186 mg., 218 mg., and 193 mg.; magnesium — 268 mg., 254 mg., 276 mg., and 176 mg.; phosphorus — 530 mg., 716 mg., 564 mg., and 480 mg.; potassium — 3.0 g., 5.4 g., 3.5 g., and 4.0 g. for the control, manure, straw, and shredded cane stalks, respectively. Similar amounts of magnesium and nitrogen were found in the tomatoes from the experimental and control plots

THE CRANBERRY STATION
EAST WAREHAM, MASS.
H. J. Franklin in Charge

Prevalence of Cranberry Insects in the Season of 1950. (H. J. Franklin.)

	Insect	*Degree of Abundance*
1.	Bumblebees and honeybees.	Plentiful.
2.	Gypsy moth	Hardly any found because of the spraying done with airplanes and helicopters by the gypsy moth authorities in Barnstable County in 1949 and in Plymouth County in 1950.
3.	Blunt-nosed cranberry leafhoppers	Normal amounts in Plymouth County to rather heavy amounts in Barnstable County.
4	Fruitworm	About normal.
5.	Black-headed fireworm	Rather less trouble than usual.
6.	Yellow-headed fireworm	Little trouble.
7.	Fire beetles	None found.
8.	Spotted fireworms	None found.
9.	Lady beetles	Very abundant.
10.	Green spanworm	Rather more generally abundant than normal.
11.	Brown spanworm	Little trouble.
12.	False armyworms	Rather scarce.
13.	Spotted and black cutworms and armyworms	Gave unusually little trouble after late holding of the winter flood and after grub flooding.
14.	Girdlers	Gave very little trouble.
15.	Spittle insect	Rather less troublesome than normal.
16.	Root grub	About normal.
17.	Cranberry weevil	This insect has been more troublesome than usual for the last two or three seasons.
18.	Tipworm	Normal.
19.	Blossom worm	Gave very little trouble.
20.	Southern red mite	About normal.
21.	Cranberry scale	This has been more widely troublesome the last two years than ever before in the history of the cranberry industry. It is also reported as troublesome in New Jersey.
22.	Brown grasshoppers	Normal.
23.	White grubs	Normal.
24.	Grape *Anomala*	Normal.

Frost Forecasts. (H. J. Franklin.) Afternoon and evening forecasting of cranberry frosts was continued as in previous years. There were 176 subscribers to the special telephone service in 1950, and 177 in 1951. Frost warnings were also sent out by radio through Stations WBZ

(Boston), WNBH (New Bedford), and WOCB (West Yarmouth) in 1950, and WBZ, WOCB, and WBSM (New Bedford) in 1951. The warnings were prepared in cooperation with the Office of the United States Weather Bureau at Logan Airport.

Fertilizer Requirements of Cranberry Plants. (F. B. Chandler and W. G. Colby.) The use of liquid fertilizer in water solution greatly reduces the cost of application and gives a very satisfactory distribution. The nutrients are absorbed from the water quite readily, even when applied in the winter flood. As liquid fertilizer gives quite a uniform distribution, it should be used as a basic application. The locations requiring more fertilizer should be treated by hand with dry fertilizer.

Cranberry Insect Control Methods. (Anthony R. Briggs.) (Extracted from Master's Thesis.) During the 1950 insect season, research was conducted in an effort to discover which of the present-day cranberry insect control methods are the most efficient as related to control and cost. These methods are: the application of insecticidal dusts by ground machine, airplane, and helicopter, the application of insecticidal sprays by ground machine and airplane, and insect control by flooding the bogs with water. The insects considered were: the blunt-nosed leafhopper[1], the blackheaded fireworm[2], the green spanworm[3], and the cranberry weevil[4]. The infestations were gauged by use of the cranberry insect net. The bogs were swept once prior to the treatment and twice after it, at two-day intervals — two and four days after control. Exceptions to this practice include some of the data gathered by the representatives of the A. D. Makepeace Company and a few cases in which the weather made the practice impossible. Data were collected every day that the weather permitted in the insect season.

The data on insect abundance, control, and reduction were subjected to statistical analysis. With the exception of some data derived from areas treated with pyrethrum, all bogs under observation were treated with DDT.

1 Scleroracus vaccinii (V. D.). 2 Rhopobota vacciniana (Pack.). 3 Itame sulphurea (Pack.). 4 Anthonomus musculus (Say.).

Analysis of the data obtained by observations and experiments revealed:

1. There was no significant difference in the relative efficiency of control of green cranberry spanworms by the applications of ground dust, ground spray, plane dust, plane spray, or by flooding.

2. There was a significant difference in the relative efficiency of the six control methods in reducing infestations of cranberry weevil.

   a. Applications of spray by ground machine and by airplane are significantly more effective than other methods. No difference was found between these two methods.

   b. Ground dust applications and control by flooding were significantly more effective than the dust applications by plane and helicopter, but considerably less effective than the ground and plane-spray applications.

3. There was no significant difference between ground dust applications and plane dust applications in the control of blunt-nosed leafhoppers.

4. Helicopter dust applications reduced black-headed fireworm infestations more efficiently than airplane dust or airplane spray applications. No significant difference was found between the airplane dust and airplane spray applications in this connection.

5. There was a significant difference in the control of the four insects by applications of dust by airplane.

a. The reduction of the blunt-nosed leafhopper and the green spanworm was significantly greater than the reduction of the weevil and black-headed fireworm by this method.

b. It appeared to reduce with equal efficiency the infestations of the blunt-nosed leafhopper and the green spanworm; the same was true of infestations of the weevil and the black-headed fireworm.

6. The least expensive method of insect control is flooding. In order of increasing expense the methods are: flooding, plane spray, ground dust, plane dust, helicopter dust, and ground spray.

7. Applications of DDT dust (50 pounds per acre) were significantly more effective than applications of pyrethrum dust (75 lbs. per acre) in the control of the blunt-nosed leafhopper and the cranberry weevil.

a. Although the number of green spanworms was small, the indications are that pyrethrum was not as effective as DDT.

Control of Cranberry Bog Weeds. (C. E. Cross.) Tests with the following weed-killers were carried out in sufficient numbers to warrant the drawing of certain conclusions: Stoddard Solvent, kerosene, alkanolamine and triethanolamine 2,4-D, triethanolamine 2,4,5-T, and copper sulfate solutions.

Stoddard Solvent can be sprayed safely on cranberry vines after October 1 at dosages up to 10 gallons per square rod. Maximum dose tests were made on several bogs in both Plymouth and Barnstable Counties, and in no case did Stoddard Solvent appear to injure the vines or reduce the crop the following year. Applications of 5 gallons or more per square rod killed all asters of all types, all summer-grass (*Agrostis*), poverty-grass (*Andropogon*), spike rush (*Juncus effusus*), canada rush (*J. canadensis*), wool-grass (*Scirpus*), and species of *Carex*; an 80 percent reduction in stands of loosestrife *(Lysimachia)*, wild roses *(Rosa)*, and small brambles *(Rubus)*. Applications of 6 and 7 gallons per square rod killed 95 percent or more of the wild roses and small brambles. In preliminary tests, Stoddard Solvent applied in October at 7½ gallons per square rod reduced the population of saw briers (*Smilax*) by 50 percent and blackberries (*Rubus*) by 75 percent.

Post-harvest kerosene sprays are limited in value because their effect on cranberry vines is unpredictable — sometimes causing complete defoliation and loss of crop for one year, and at other times causing no apparent injury at all. In the fall of 1950, three series of experiments were made on widely separated bogs in Plymouth County with no vine injury resulting. Where kerosene was applied at 7½ and 10 gallons per square rod in October, at least 75 percent of the saw briers and over 60 percent of the blackberries were killed.

Mixed alkanolamine salts of 2,4-D regularly produced some volatilization vine burn when applied in 20 percent solutions to the tips of tall

weeds by the "wet glove" method. Even when the tall weeds were treated with these same solutions by gently brushing them with a swabbed hockey stick, it caused some injury to the cranberry vines beneath. Little or none of this form of injury occurs when the same methods are used to apply 20 percent solutions of the triethanolamine salt of 2,4-D. Both of the above salts have been used with some success in killing loosestrife, swamp loosestrife (*Decodon*), hardhack and meadow sweet (*Spiraea* spp.), 3-square grass (*Scirpus*), marsh St. John's-wort (*Hypericum*), and royal fern (*Osmunda*).

The results of spraying cranberry bog shores for the control of poison ivy, grape vines, saw briers, and bull briers were made more consistent by the addition of the triethanolamine salt of 2,4,5-T to the above salts of 2,4-D, in the proportion of 1 to 2.

Extensive preliminary tests were made during the last year to find inexpensive and selective weed-killers for the woody weeds of cranberry bog shores. To date, it appears safe and profitable to use amine salts of 2,4-D and 2,4,5-T for the control of poison ivy, wild grapes, chokeberry, wild cherry, morning glory, hardhack, meadow sweet, etc., on the shores of cranberry bogs and even in shore ditches, provided that no spray is allowed to drift onto adjacent cranberry vines. The best dilution appears to be 1 cupful of 60 percent concentrate (4 pounds 2,4-D or 3.3 pounds 2,4,5-T per gallon) in 4 gallons of water. Best results follow a spray of 250 gallons an acre in warm, dry, and sunny weather.

Several sprays made by dissolving copper sulfate in water were tested in August. The most satisfactory concentration was found to be 25 pounds in 100 gallons of water. This solution, sprayed at 250 to 300 gallons an acre, kills over 90 percent of the following weeds: warty panic-grass (*Panicum verrucosum*), fireweed (*Erechtites*), pitchforks (*Bidens*) and nutgrass (*Cyperus dentatus*). Early in August, this spray causes tiny specks to appear on some of the green berries. This trouble does not develop later in the month when the berries are partly colored. To be most effective in weed control, the spray should be applied on the annual weeds previously mentioned before they have produced mature seeds.

Winter Protection. (C. E. Cross.) A year ago, it was reported that rather concentrated sprays of wax on cranberry vines to prevent winterkilling increased the frost sensitivity of the treated vines the following spring. Tests of more dilute wax sprays in December, 1950, have shown no increase in frost susceptibility, but, because winterkilling conditions were not present during the mild and open winter of 1950 and 1951, it was not known whether or not these more dilute sprays offer sufficient protection.

DEPARTMENT OF DAIRY INDUSTRY
D. J. Hankinson in Charge

Sanitizing Agents for Dairy Use. (W. S. Mueller.) From a sanitary standpoint, no other operation is more important in the production of high quality dairy products than the cleaning and sanitizing of dairy utensils and equipment. Hot water is essential for satisfactory washing, but unfortunately most dairy farms do not have an adequate supply of hot water for this purpose. Although steam is an excellent sanitizing agent, it is not as essential as hot water on the dairy farm because chemical sanitizing agents may be used in place of the steam. Both steam and chemicals have advantages and limitations as sanitizing agents for dairy use.

1. *Sanitization of Dairy Utensils by Heat.* (W. S. Mueller and W. T. Geenty.) Further studies were made to find a practical method of supplying hot water and steam for dairy farm cleaning and sanitization. The sanitization capacity of a small equipment unit consisting of a heater (available for burning natural or manufactured gas, stove oil, kerosene, or Diesel oil), a two-compartment wash sink, and a sterilizing cabinet was investigated. The efficiency of the heater, which will produce either hot water or steam, was also measured. It was found that the heater would produce hot water or steam within two minutes after lighting the burner. Milk cans or pails were effectively sanitized when steamed for three minutes within the steam chest or when placed for 30 seconds over the steam jet. The burner was found to be 70 percent efficient in fuel consumption (bottled gas), which by engineering standards is considered to be very good. When bottled gas was used, the cost of producing hot water and steam for cleaning and sanitizing the utensils on an average size dairy farm (20 cows) was calculated at 21 cents per day. Results of this study show that this type of steam sterilizer is both effective and efficient in its operation and could lend itself very satisfactorily to New England dairy farms.

2. *New Chemical Sanitizing Agents.* (W. S. Mueller.) The ideal chemical sanitizing agent for dairy use should be colorless, odorless, tasteless, stable, nontoxic to humans, noncorrosive, not adversely affected by organic matter or hard water, inexpensive, and should have bacteriostatic action as well as germicidal action. The dairy industry is now limited to two types of chemical sanitizing agents; namely, chlorine and quaternary ammonium compounds. Both of these chemicals have sufficient limitations to make it desirable to look for better sanitizing agents. Various resorcinol compounds, chlorinated phenols and chlorinated morpholinium compounds have been studied as possible sanitizing agents for dairy use. Although many of these products have excellent germicidal properties, they have not been perfected to the point where they can be recommended for replacing the chlorine or quaternary types of sanitizing agents.

In quaternary investigations it was found that as little as 5 to 10 p.p.m. of quaternary in the milk would significantly retard acid and curd formation in the manufacture of cottage cheese. Thus, dairy farmers and milk plant operators should use sanitizing procedures that will avoid contamination of the milk with inhibitory concentrations of quaternary.

DEPARTMENT OF ECONOMICS
Philip L. Gamble in Charge

Public Land Ownership in Rural Areas of Massachusetts. (David Rozman.) With the growth of urban centers and the increase of city population over a period of years, there has been a considerable expansion of public land ownership in rural areas of Massachusetts at both the State and local levels, especially to satisfy the need for land, water supplies, recreational developments, highway systems, and other requirements of public convenience, health, and safety. Likewise, large areas of land have come into public ownership in the interest of conservation of natural resources with special consideration for the development of systematic forest culture.

The expansion of public ownership in rural areas has left its mark and is having a continuous effect on the rural communities and the agricultural land utilization of the State. Hence, the primary purpose of this study is to appraise this effect on the local population and on agriculture in general. The investigational work so far has been directed towards the determination of the extent and character of public land ownership by obtaining pertinent information from both State and local sources.

DEPARTMENT OF ENTOMOLOGY
A. I. Bourne in Charge

Insecticides Control European Corn Borer and Increase Yields. (A. I. Bourne.) Methods for European Corn Borer control involve applications of sprays or dusts into the central whorl, emerging tassels, and young-forming ears at 5 to 7 day intervals during the hatching period to place the poison on the points where the young newly hatched larvae feed.

When 1/3 to 1/2 grown, the larvae burrow deeper in the stems or ears and become true "borers." Control measures to be effective must reach the young caterpillars in the early stages of their development. The rapid growth of the corn during the hatching season, varying dates of planting, and type of season combine to make proper timing difficult.

The adult moths, however, seldom are attracted to corn until it has reached a height of 10 to 12 inches to the base of the central whorl. Plantings, therefore, in which the corn has reached this state at the beginning of the hatching period or later plantings that will reach that height during the 3 to 4 week period of larval appearance should receive spray or dust application.

Experience has shown, however, that, in general, regardless of the growth stage of the corn the most accurate measure of timing the insecticidal treatments is to base them upon the first hatching of the egg masses in the field. Individual growers should learn to discover the egg masses in their own particular fields and to recognize the different stages of egg development to determine accurately when to begin their spray or dust schedule.

If treatments are delayed, the early appearing larvae will work deep into the stalks beyond the reach of later sprays and thus remain undisturbed for their total larvae life, lowering the vitality of the plant and reducing the size and quality of the ears.

These larvae also pass into pupation and furnish a sizable second brood. If only the late-appearing larvae escape treatment, they can cause little damage to the plant or ears and furnish few pupae for the later brood and delay its appearance. This prolongs the length of the "free period" between broods during which corn in this area requires no treatment.

Field experiments have shown that proper materials accurately timed will allow a very high percentage of borer-free corn, a larger percentage of the total yield being of marketable grade, and an actual increase in number of ears. Commercial growers are demonstrating this in their own fields. Field tests in Massachusetts in a season of moderately heavy abundance showed that 95 percent of the ears from treated plots were borer free and 94 percent of the total yield was of marketable grade. In the check plots, however, 64 percent of the yield was free from borers but only 55 percent of the total yield in the earliest pickings were of marketable grade and only 33 percent of the late picking were salable ears.

Many of the earlier materials used for borer control retained their effectiveness for only a 3- or 4-day period. To cover the hatching period a schedule of 4 applications at 5-day intervals was necessary. Field experiments at this station have shown that DDT and other newer insecticides give protection for a longer period and that a schedule of 3 applications at 7-day intervals will give adequate protection, eliminating completely the cost of one application.

The application of DDT, Parathion, and similar materials to corn involves so much risk from poison residue that corn so treated is not recommended to be fed to stock. The use of Ryania does not involve such a hazard.

The field experiments in 1950 involved studies of different formulations of Ryania alone and with the addition of activating agents in both spray and dust applications. Yield records showed 99 percent of the ears in the treated plots to be uninfested and 88 percent borer free ears in the checks. Even in the face of a light infestation following spring weather conditions unfavorable for corn borer moth activity, there was an increased yield of marketable ears per thousand plants over the untreated plots.

Records over a 5-year period of the yield on the same farm showed increased yields following borer control treatments.

Even in seasons of light infestation (1945 to 1950) there was a slight increase in yield following treatment, and in a season of moderate to heavy attack (1949) the differential was of significant proportions.

No. 1 Insect Enemy of Apples Controlled by Methoxychlor. (W. D. Whitcomb, W. J. Garland, and C. S. Hood.) As in several previous seasons, the plum curculio was the most destructive insect pest of apples in 1950 especially in eastern and central Massachusetts. At least, 90 percent of the apples on unsprayed trees were damaged, and in some commercial orchards where sprays were poorly made, incorrectly timed, or where ineffective materials were used, the injury reached 15 to 20 percent. Maximum activity took place June 1 to 13, 1950, when high temperatures stimulated feeding and oviposition by the overwintered

beetles and definitely corroborated the results of temperature studies in recent years. Under these conditions, the recommended insecticide formulation, lead arsenate-DDT, failed to give satisfactory protection under grower conditions and in the experimental tests permitted 11 to 14 percent of the apples to be stung. Grower criticism was strong, and the demand for better control was great.

Fortunately, preliminary experiments had shown much promise from methoxychlor, a newly formulated analog of DDT, and orchard tests confirmed the value of this insecticide for control of the curculio. Methoxychlor as a 50 percent wettable powder used alone at 3 pounds, or at 2 pounds in combination with 2 pounds of lead arsenate or with 2 pounds of 50 percent TDE (DDD), in 100 gallons, gave 99.32 to 99.60 percent protection in the experimental orchard tests. Although there was no significant difference among the formulations containing methoxychlor, the most practical and economical spray appeared to be the methoxychlor-lead arsenate combination. Several commercial orchardists who used this combination on a trial basis reported outstanding control of curculio and will use it extensively the following season. It will be officially recommended in the spray schedules for the coming season.

In experimental orchard tests, other insecticides gave better control than the treatments previously recommended. Combinations of 25 percent Aldrin wettable powder 2 pounds plus 50 percent DDT 1 pound, and 2 pounds of 15 percent parathion wettable powder plus ¾ pound of charcoal as safener for McIntosh apple foliage, both gave 95 percent protection. Further studies of these and other similar insecticides should prove their value, and there is great promise for much better control of the plum curculio in the future.

Chlorinated Hydrocarbon Insecticides Replace Corrosive Sublimate for Cabbage Maggot Control. (W. D. Whitcomb, W. J. Garland, and C. S. Hood.) The cabbage maggot continues to be a major pest of crucifers, and growers of these crops frequently lose 5 to 20 percent of their plants in spite of treatment with insecticides. Much of this loss is due to failure to apply the treatments when the first eggs are laid by the cabbage maggot fly. Experiments have shown repeatedly that treatments applied within 48 hours of the time the first eggs are laid are more effective than later applications. Two applications of insecticides at an interval of 7 to 10 days are always more effective than one, and usually are necessary for successful control with dusts.

In 1950, at Waltham, cabbage maggot eggs were first found on May 4, and the treatments described below were applied the following day and, in most cases, repeated one week later. In the experimental plantings, 65 percent of the untreated cabbage was damaged by this insect. Under these conditions, the old standard treatment, corrosive sublimate, 1 ounce in 10 gallons of water, applied as a drench of ½ cupful per plant in two applications gave perfect protection, but one application permitted 3.3 percent injury. In a similar drench application made once, a 74 percent chlordane emulsion diluted at 1½ quarts per 100 gallons or 1 ounce in 1 gallon gave perfect control but may have caused some plant injury because 12 percent of the heads were below normal size.

The most effective dust applications were with 1.5 percent lindane and 3 percent Aldrin. Although 3 percent chlordane dust gave very good protection when used in two timely treatments, one application of this dust was the only treatment that failed to give satisfactory protection. Dusts are becoming more popular because of the ease of application, and following the satisfactory control obtained in these experiments they will be used in greater volume.

Soil Insecticides Make Greenhouse Carnations and Roses Immune to Pests. (W. D. Whitcomb and C. S. Hood.) Greenhouse florists have shown considerable interest in a practical method for controlling red spider and other pests by a soil treatment that is absorbed by the plants to make them immune. Experiments of this kind were started on both carnations and roses using two systemic organic phosphate formulations called E-20/58 and E-1059 (Systox). Preliminary tests soon showed that E-1059 was the more effective, and further studies with it were made.

On carnations a dosage of 1 pint per square foot of E-1059 diluted 1-16000 was unsatisfactory, but a dosage of 1 quart per square foot in two applications three weeks apart reduced the population of red spider mites to a minimum and prevented a harmful reinfestation for 50 days. In another test a spray of E-1059 1-16000 followed in three weeks by a soil drench at the rate of 1½ pints per square foot was still giving complete protection after 76 days.

On roses in benches mulched with corncobs, E-1059 diluted 1-16000 failed to give satisfactory results at a dosage of 1 quart per square foot, but when applied at 2 quarts per square foot, it reduced a population of 90.2 spiders per leaf in four replicates to 0.65 spiders per leaf and maintained that protection for three weeks. A spray of this formulation in a 0.1 percent solution completely controlled an infestation of 8.9 spiders per leaf and allowed a buildup of only 1.45 spiders per leaf in 31 days.

New Sprays Control Pest which Threatens Birch Trees. (W. W. Cantelo.) The most spectacular and destructive insect pest of shade trees in 1950, especially in eastern Massachusetts, was the birch leaf miner, *Fenusa pusilla*. Although the common grey birch was the most heavily infested species in the area, all species and varieties including twenty rare kinds at the Arnold Arboretum were attacked.

This sawfly has four annual generations with the adults appearing about May 15, June 25, July 25, and August 30, and all newly opened leaves may be infested. Since nearly all leaves are newly opened in May, the first generation causes the most injury.

Preliminary laboratory studies with insecticides indicated that parathion, DDT, and toxaphene were quite effective in preventing oviposition but that parathion caused some leaf injury. BHC 25 percent gamma and chlordane killed large numbers of eggs, and BHC gave 100 percent control of larvae.

In field experiments, toxaphene (40 percent wettable powder 3 pounds per 100) was significantly effective in killing the eggs. However, the most practical treatment was spraying when the majority of the larvae had hatched but had not enlarged their mines enough to

damage the leaf seriously. As a larval spray, BHC (25 percent gamma isomer 3 pounds per 100) and toxaphene (40 percent wettable powder 3 pounds per 100) were the most effective treatments. They will be the recommended treatments for the coming season.

FEED AND FERTILIZER CONTROL SERVICES
John W. Kuzmeski in Charge

Feed, fertilizer, and milk testing laws are administered as one service, and the operations of each, with the exception of the milk testing law, are reported in annual control series bulletins.

Under the milk testing law 4,907 pieces of Babcock glassware were calibrated and 212 certificates of proficiency in testing were issued. All milk depots and milk inspection laboratories in the Commonwealth were visited at least once to check apparatus and general conduct of the work.

In addition to the regulatory work, the Feed and Fertilizer Control laboratories have examined feeds, fertilizers, and other agricultural materials for citizens of the Commonwealth without charge whenever the results were considered of interest to the general public or to the Control Services. Samples of feed, stomach contents, and viscera of animals have been tested for the presence of toxic ingredients.

Considerable work has been done on research projects in cooperation with other departments of the University and Experiment Station. The results of such work are reported by the departments originating the projects.

DEPARTMENT OF FLORICULTURE
Clark L. Thayer in Charge

"Time-Pinching" Produces Good Flower Spray Formation on Pompon Chrysanthemums. (N. W. Butterfield, Waltham.) From experiments at the Waltham Field Station, it has been found that "time pinching" is the best method of producing good flower spray formation on chrysanthemums. Catalogs of many companies that sell rooted cuttings list the dates when individual varieties should be pinched. The rooted cuttings should be planted directly from the propagating sand into the bench 14 days before the date of time for pinching the variety. Cuttings taken earlier, allowed to become hard and then pinched, produce inferior types of spray and inferior flowers.

The grower who wishes to control the type of spray of a particular variety to suit his needs can accomplish this result by manipulation of shade and light. The plants should be shaded from 5:00 P.M. to 8:00 A.M. from August 12 to 19 and given additional light to 10:30 P.M. from August 19 to September 1. With some varieties, the length of the laterals will be increased, and a larger number of flowers will be produced. In those varieties that have a tendency to produce compact clusters of flowers the character of the clusters may be altered by variations of the short and long day periods previously suggested.

The flowering period of a variety may be prolonged from four to eight weeks by giving the plants a day length of 14 hours. This lighting period should begin before the flower buds set normally, preferably by August 1, the additional light should be given from 6:00 P.M. to 10:00 P.M. A required light intensity of 15 to 20 foot candles is provided by the use of 40 watt bulbs in suitable reflectors placed 40 inches above the plants and spaced at intervals of four feet.

Spectograph Tests to Determine Causes of Plant Ailments. (N. W. Butterfield, Waltham.) In the fall of 1950 a rose grower came to the Waltham Field Station with the problem of spots that develop on rose petals during shipment to market. It was found that spots developed to a greater extent in the spring and fall months during which times a product containing sodium antimony lactophenylate was used to control thrips.

Antimony is reported to be very toxic to plant tissue, but no reports were found indicating that this substance was toxic if used at the recommended rates. Since it appeared that this product might cause the spotting, samples of normal and spotted petals were taken to the Laboratory of the New England Spectograph Company for analysis on the spectograph, a modern instrument that will test for 69 chemical elements even if these chemicals are present at very low concentrations. The spectograph test is rapid and requires a minute amount of plant tissue.

The result of this test indicated that the spotted petals were high in antimony, whereas the normal petals did not show the presence of the element. Since antimony, therefore, was considered to be the cause of the spotting, its use was discontinued.

Flower Growers, Watch Soluble Salts! (N. W. Butterfield, Waltham.) The presence of soluble salts in soil has a harmful effect on the production of florists' crops. Severe injuries have developed on such crops as snapdragons, chrysanthemums, and carnations. Because of the increasing scarcity and expense of good soil, there is less annual changing of greenhouse soils. In addition, with new methods of production, more fertilizer is now added to the soil, thus causing such an accumulation of soluble salts that plant growth is injured.

Experiments have shown that three applications of gypsum (calcium sulfate), at two pounds per 100 square feet of bench per application, double the normal soluble salt content of the soil. The calcium is used up by the plant or absorbed by the soil, leaving behind the sulfate radical, which plants do not use in their diet.

Soluble salts may accumulate from using too much manure. This accumulation is noticeable in particular after sterilization of soils that contain high percentages of manure. Overfeeding, improper watering, and allowing benches to become dry are other causes of soluble salt accumulation.

Proper leaching of the soil will keep the soluble salts within a safe range. For some soils, two gallons of water per square foot is sufficient; for others, particularly heavy soils, five gallons may be required. The best time to leach the soil is before the old plants are removed. A soil test should be made just before the plants are taken out; if the salts

are found to be high (80 to 100 on the International System), the soil should be thoroughly leached before taking out the old crop. When mature plants are left in the bench, they aid in drying out the soil. Puddling and uneven leaching will result if the soil is leached after removal of the crop.

The Control of Red Spider Mites on Sweet Peas with a Systemic Insecticide. (Harold E. White.) Among the many recent materials found outstanding for control of insect pests are the compounds known as organic phosphates. Some of these well-known insecticides are Parathion (paranitrophenyl diethylphosphate), HETP ((hexaethyl tetraphosphate), TEPP (tetraethyl pyrophosphate) and TEDTP (tetraethyl dithiopyrophosphate). These organic phosphate materials have been offered on the market under several trade names, suitable for use as liquid sprays, dusts, and aerosol bombs.

Recently another phosphate material, OMPA (octamethylpyrophosphoramide), has attracted considerable interest because, when applied to soils in a water solution or to the foliage of plants, it is absorbed by the plant tissues. Insects, particularly sucking kinds, such as red spider mites and aphids or plant lice (green fly), are killed when they feed on plants treated with OMPA. Chemicals of this nature, which are absorbed or taken into the internal system of plants, are termed systemic poisons; hence, we have a method or procedure of treatment of plants for insect control known as systemic plant therapy.

Compared with sodium selenate, which is also a systemic poison, new phosphate insecticide has certain advantages in that it does not, so far as is known, remain indefinitely in the soil or plant tissues. Also, it is reported harmless to beneficial insects known as predators and pollinating insects such as bees. The new OMPA insecticide should be treated with the same respect and precautions given for handling other organic phosphate insecticides, as all are poisonous. OMPA insecticide is offered to the public under such trade names as Pestox, Systox, and others.

This new material has been used experimentally on a number of plants such as Roses, Lilies, Chrysanthemums, and Saintpaulias. Some forage crops and vegetables have been treated, but *OMPA should not be used on such crops until further tests are made.*

Tests herein reported deal with the use of octamethylpyrophosphoramide on Sweet Peas for control of red spider mites. Sweet Peas of the Cuthbertson strain, variety Lois, were grown under glass in 6-inch clay pots. The soil was treated with water solutions of OMPA when the plants were 8 inches high, on April 30. The chemical obtained from the Dow Chemical Company, Midland, Michigan, under the number C-1014, was indicated as containing 63.3 percent of technical grade octamethylpyrophosphoramide.

The soil in which Sweet Pea plants were growing was treated with 4 different strength water solutions of OMPA; namely, 1 to 200, 1 to 400, 1 to 800, and 1 to 1000. These dilutions are, respectively: 4 tsps., 2 tsps., 1 tsps., and ¾ tsps. per gallon of water. The amount of solution applied to each pot of soil was 100 ml. or approximately 3¾ fluid ozs.

The Sweet pea plants were artificially inoculated with red spider mites 7 days previous to treatment. Only one application of OMPA to the soil during the 60-day test period was found to be very effective in the control of red spider mites. Dilutions of 1 to 200 and 1 to 400 gave complete control, whereas to 1 to 800 and 1 to 1000 were quite effective as compared to untreated plants. Injury to the plants from any of the treatment was not indicated, and the plants flowered normally.

At the end of 50 days, the untreated plants, compared to treated plants, lost most of their leaves from infestation of red spider mites and were much lighter in foliage color. The treated plants were still in good condition in mid-July and are being maintained to determine the length of effectiveness of the different treatments and to allow seeds to develop to determine whether the OMPA is transmitted to the seeds.

DEPARTMENT OF FOOD TECHNOLOGY
Carl R. Fellers in Charge

Pasteurized Fresh Whole Cucumber Pickles. (W. B. Esselen, Jr., E. E. Anderson, I. S. Fagerson, L. F. Ruder, Jr., and M. Labbee.) Within the past 15 years, Country Style, Kosher Style Dill, Old-Fashioned Dill, and other pickles of this type have gained wide public acceptance. These unfermented pickles are made by packing fresh cucumbers in jars, covering them with a brine of low concentrations of salt and vinegar, adding essential oils, dillweed, garlic, and spices for flavoring, and finally pasteurizing to destroy microorganisms that might cause spoilage or to inactivate enzymes producing off-flavors during storage.

In the laboratory and in some commerical pickle plants, data have been obtained for evaluating variations in heating rates, processing values, brine volume to acidity ratios, firmness, and pasteurization requirements to prevent spoilage in pickles. An important cause of the great variation in the rate of heat penetration into quart jars of fresh whole pasteurized pickles was found to be the nonuniformity of pickles as packed. Pasteurization times and temperatures adequate to prevent spoilage had no adverse effect on the firmness or flavor of the pickles.

Occasional off-flavors are due to substances called enzymes within the pickles; these enzymes possess greater heat resistance than the common spoilage agents, bacteria and yeasts, in pickles. Pasteurization times derived from this investigation were adequate to destroy both microorganisms and enzymes responsible for either spoilage or off-flavors in pickles.

Salt and Acid Tolerance of Spoilage Organisms. Pickle spoilage organisms were capable of growing and causing spoilage in pickles and of growing in pickle brine containing 5.5 but not 6.5 percent salt and in pickle brine containing 1.4 but not 1.6 percent acetic acid. Thus, the brine in jars of fresh pack whole pickles, which usually contains from 0.4 to 0.9 percent acetic acid and about 2.5 percent salt, could not be expected to prevent the growth of spoilage organisms. Likewise, because of their acid and salt tolerance it would not be practical to prevent spoilage in this type of product by increasing the acid or salt content of the brine.

Heat Resistance of Spoilage Organisms. The heat resistance of a yeast that caused spoilage in pasteurized fresh whole pickles decreased with increasing concentrations of acetic acid in the brine. Within practical limits, the salt concentration of the brine had no significant effect on heat resistance. The addition of a Kosh-A-Dill essential flavoring oil mixture in the brine exerted a definite effect in decreasing the heat resistance of the yeast. Mustard oil exerted a similar effect.

Peroxidase in Acid Foods. (W. B. Esselen, Jr., M. Labbee, and E. A. Nebesky.) Previous work in this department has shown that peroxidase is one of the most heat resistant enzymes found in plant material. When this enzyme is not inactivated it has been implicated as a cause of off-flavor and discoloration in processed foods. Heat treatments adequate to destroy enzymes in food products, under various conditions, may be calculated by an integration of the rate of heat penetration into the product with the destruction rate of the enzyme in the particular product under consideration.

Peroxidase in Fresh Cucumber Pickles. A general correlation has been observed between the intensity of peroxidase activity and the development of off-flavors in fresh cucumber pickles. It would appear that to prevent such off-flavors caused by peroxidase activity, it is necessary only to provide sufficient heat treatment to reduce the enzyme activity to a low level rather than to destroy it completely.

Apple Juice. When apples are bruised, crushed, or ground, they release an extremely active oxidizing enzyme that causes a rapid browning of the flesh and liquid portion of the fruit. This reaction causes the flavor of the natural apple juice to develop a ciderlike flavor. The enzyme peroxidase is believed to be directly implicated in this change. To retain a maximum of fresh apple flavor in apple juice, therefore, it is necessary to inhibit or inactivate the peroxidase as soon as possible during the manufacturing process. During the past season, data on the thermal inactivation times for peroxidase in Baldwin, Red Delicious, and McIntosh apples were obtained and applied successfully in an apple juice processing plant. The stability of peroxidase towards heat may vary with different varieties of apples.

Cranberry Investigations. (W. B. Esselen, Jr., E. E. Anderson, I. S. Fagerson, C. R. Fellers, and M. Tatro.) (In cooperation with the Massachusetts Cranberry Experiment Station, East Wareham, and the National Cranberry Association, Hanson, Massachusetts.)

In 1949, it was found that conditions under which cranberries were grown had a significant effect upon the composition and jellying properties of the fruit. During the past year, studies of fruit grown on two different bogs in New Jersey confirmed these findings. Likewise, a study of fruit from several selected bogs in Massachusetts indicated an effect of bogs and growing conditions on the composition, quality, and benzoic acid and pectin content of cranberries. The practical significance of these observations has yet to be determined; however, a high pectin content in cranberries is conducive to good yields and quality of cranberry sauce.

Rodenticide Investigations (L. R. Parkinson). The extreme variability in the quality of Fortified Red Squill offered for sale in Massachusetts this past year seems to be due to the poor crop of crude squill produced in 1950.

Warfarin (Compound 42) [3–(alpha-acetonylbenzyl)–4–hydroxycoumarin], a recently discovered rodenticide, has become very popular in rodent control operations throughout the country, and sensational publicity has given it high public acceptance. The results of check tests and other tests in progress indicate that some of the claims made for Warfarin are somewhat exaggerated; however, this material appears to be one of the best rodenticides yet developed.

Nontoxicity of Ethylenediaminetetracetic Acid (Sequestrene). (C. R. Fellers, L. R. Parkinson, and S. S. Yang.) The feeding tests reported a year ago have been extended somewhat. A 5 percent level of Sequestrene in the daily ration was fed. This level of feeding, being abnormally high, might be expected to prove somewhat toxic; however, the rats on this feeding level have shown only slightly less growth than the controls, probably because of their smaller food intake. *(T.D.N.)* No deaths have occurred at this level for the past 15 months. Post-mortem examinations, including microscopic tooth studies, have not shown any observable differences from the controls.

Frozen Concentrated Citrus Juices as Sources of Ascorbic Acid (Vitamin C). (E. E. Anderson and I. S. Fagerson.) Varietal differences in citrus fruits as well as unfavorable storage conditions on the part of the manufacturer, wholesaler, and retailer have been known to influence the final ascorbic acid content of frozen citrus concentrates. Furthermore, many people rely on citrus juices as the major source of ascorbic acid. Thus, with the tremendous increase in both production and popularity of the frozen citrus concentrates, it was considered desirable to determine their ascorbic acid content at the time of purchase in the retail market. It was observed that not only was there considerable variation in the ascorbic acid content between different brands of concentrate but even within some samples of the same brand. The latter was usually true when concentrates sold under the same label were packed in different plants or by different companies.

In general, the average vitamin C concentration of all brands approximated 45 milligrams per 100 milliliters of reconstituted juice with extreme ranges of 28.7 to 51.2 milligrams.

Discoloration of Strained Apple Sauce. (G. E. Livingston, I. S. Fagerson, and W. B. Esselen, Jr.) To find the fundamental causes of storage browning in many types of strained fruit and vegetable products, apples were selected because they do not possess strong natural pigments, which, by undergoing storage changes, might interfere with the observation of the development of color changes associated with the so-called "browning reaction."

An experimental pack of apple sauce is being studied for quantitative changes in some of the constitutents believed to be related to the nonenzymatic discoloration. These include malic acid, the sugars (glucose, fructose, and sucrose), pectin, and 5-hydroxymethyl-2-furaldehyde, which has been identified previously in storage-browned apple sauce. The chemical nature of this furaldehyde compound, a sugar breakdown prod-

uct, is such that it is believed to be an intermediate in the formation of substances causing browning. The effect of certain variables, upon the above constituents and upon the development of color formation, is also being studied in this pack. These variables include storage temperature, head space gases, cap metals, skin pigments, malic and ascorbic acids, glucose, fructose, and sucrose.

As an additional means of elucidating the chemical reactions that cause discoloration in apple sauce, a study of possible interactions between single constituents of apple sauce was initiated using pure chemicals. Of the primary constituents only, a mixture of fructose and malic acid in solution was found to react to form dark-colored products. This system is being studied to determine the rates of reaction, the effect of atmospheric gases, and temperature, and the nature of the substances formed.

Heat Transfer in Commercial Glass Containers during Thermal Processing. II. F_0 Distribution in Foods Heating by Convection. (I. S. Fagerson, W. B. Esselen, Jr., and J. L. Licciardello.) Previous work on heat transfer in glass containers utilizing 1 percent bentonite suspensions to obtain convection type heating indicated that minimal F_0 values did not occur on the vertical axis of the container but were found between the vertical axis and the jar wall. In view of the fact that sterilizing processes for foods are generally based on the assumption that these F_0 values or sterilizing values are found on the vertical axis, it seemed desirable to determine the significance of off-center minimal sterilizing or process values in actual foodstuffs that exhibit convection type heating. Accordingly, heat penetration studies were made on three such types of food products; namely, cut green beans, diced carrots, and apple juice.

Although these minimal sterilizing values were also found in the food studied, the magnitude of these values indicates that the effect is much less pronounced on foodstuffs than in 1 percent bentonite suspensions. Although nonsymmetrical process value distribution apparently occurs in foods heating by convection, it appears to exhibit at most only a small effect on the calculated process values.

Dietetic Fruit Packs. (E. E. Anderson, W. B. Esselen, Jr., and C. R. Fellers.) A noticeably expanding interest on the part of food processors manufacturing dietetic foods has been evidenced in recent years. That type of dietetic pack wherein sugar is replaced with a noncaloric sweetener is of special interest to the million or more diabetics in the United States. In addition, such foods are in considerable demand by people who are attempting to lose weight or are otherwise restricted in their intake of carbohydrates.

Recently, a new noncaloric sweetener, "Sucaryl Sodium" (Sodium cyclohexylsulfamate) has been made available, and is about thirty times sweeter than sucrose. It is claimed to have the following advantages over saccharin when used in canned fruit: 1) no bitter after-taste if used in moderate amounts and 2) no decomposition in cooking, baking, or boiling temperatures.

With experimental packs of canned sweet cherries, raspberries, and blueberries little difference was noted between the standard sugar and the "Sucaryl Sodium" packs. However, with both peaches and pears,

sirups prepared with "Sucaryl Sodium" lacked the "body" or viscosity of the standard sucrose sirup. Initial attempts to incorporate small amounts of pectin and other thickeners in the "Sucaryl Sodium" sirups to increase their viscosity met with some success.

Canned fruits sweetened with saccharin were less desirable than similar packs prepared with either sucrose or "Sucaryl Sodium."

Prepeeled Potatoes. (E. E. Anderson, D. E. Westcott, and W. B. Esselen, Jr.) In view of the fact that hotels, restaurants and other institutions have exhibited considerable interest in prepeeled potatoes, investigations were carried out to find the most effective way of prolonging the storage life of this item.

Potatoes are generally prepared by peeling, chemically treating to prevent discoloration, packaging, and finally refrigerating until needed by the consumer. The more obvious advantages of the prepeeled over the regular potato include the elimination of 1) labor and time for peeling, 2) waste disposal problems, and 3) bulk storage. In addition, some prepeeled-potato operators are considering separating their stock, by means of differences in specific gravity, into different categories of cooking potatoes (i.e., bakers, boilers, etc.), thereby providing their customers with potatoes of uniform cooking quality.

Inasmuch as raw peeled potatoes discolor within a few hours if exposed to the air, various chemical dipping treatments were evaluated for their ability to prevent or delay effectively this discoloration.

Since salts containing available sulfur dioxide were the most effective of all the chemicals evaluated, the following treatments are those that resulted in storage lives of at least three weeks when the peeled potatoes were packaged and stored at 35°F:

a) Immersion of the peeled potatoes for 15 seconds in an aqueous solution of sodium bisulfite containing 10,000 parts per million (p.p.m.) of available sulfur dioxide (1.62 pounds of sodium bisulfite in 12 gallons of water).

b) Dipping the peeled potatoes for eight minutes in an aqueous solution of sodium bisulfite containing only 3000 p.p.m. of available sulfur dioxide, that is, approximately 0.54 pounds to 12 gallons of water.

Quality of Processed (Canned and Frozen) Foods. (I. S. Fagerson, E. E. Anderson, C. R. Fellers, and K. M. Hayes.) During the past year, considerable work on evaluating the quality of various commercially canned and frozen food products has been carried out. The purpose of the investigation was to determine the general level of quality available to the consumer at the retail level. Items representing the most popular brands were purchased in major cities over the entire country. Products examined include canned baked beans, canned tomatoes, fruit cocktail, tuna fish, frozen fish, fillets, sweet potatoes and green snap beans. Only canned sweet corn and fruit cocktail are discussed here.

Six samples each from 30 to 50 principal brands of a food commodity were evaluated using the United States Department of Agriculture Standards for Grades whenever applicable grades existed.

Canned Corn. Of 39 leading brands of canned corn tested, 20 were cream style and 19 were whole kernel packs. On the basis of retail prices paid for the same brand, whole kernel corn was generally more expensive than cream style corn. Whole kernel corn was also more expensive when vacuum packed than when brine packed; however, in all types of pack, retail prices generally provided no reliable guide to quality.

Of the 20 brands of cream style corn, only two met the standards for U. S. Grade A or U. S. Fancy; 11 were U. S. Grade B or U. S. Extra Standard; four were U. S. Grade C or U. S. Standard; and three were U. S. Grade D or Substandard.

Of the 19 brands of whole kernel corn, eight met the specifications for U. S. Grade A and 11 were U. S. Grade B.

Canned Fruit Cocktail. The importance of this commodity is evidenced from the fact that in 1949 canned fruit cocktail reached third in size of all canned fruit packs. In general, the over-all quality of this canned product, as purchased on the retail market, was fairly high. Again, price alone was no indication of the quality of the contents. Of the 32 brands examined, 18 were U. S. Grade A; 11, U. S. Grade B; and three, U. S. Grade D or substandard. Prices paid for the regular family size can (#2½) ranged from a low of $0.33 to a high of $0.54.

DEPARTMENT OF HOME ECONOMICS NUTRITION
Anne Wertz in Charge

The Nutritional Status of Pregnant Women. (A. W. Wertz, M. E. Lojkin, G. C. Hagan, C. E. Dietz, and L. Guild.)

A study of the nutritional status of expectant mothers and its relationship to complications during pregnancy and to the physical condition of the child at birth was carried on in conjunction with the Northeast Regional Cooperative Project on Nutritional Status. Methods in this study included (1) dietary studies, (2) biochemical studies of blood and urine, and (3) physical and medical examinations of mother and child. The final treatment of the experimental data will be correlation studies between the findings of the different methods used. These correlations will be made not only to determine the nutritional status of the individuals studied, but also to evaluate each method as a means of assessing nutritional status. In addition to these correlation studies, evaluations of the physical condition of the child at birth and the possible influence of the mother's nutritional status on the complications during pregnancy and parturition will be made. Although such interpretation of the data has not yet been possible, there are several interesting facts that have become evident in the course of the study.

One of the major problems in this study was concerned with finding in the most satisfactory and feasible manner just what an individual eats and how much. It has been found that, if the food intake of a homemaker is obtained by an interview between the homemaker and a dietitian, the homemaker usually overestimates the amount of food that she eats in comparison with an actual record of the food eaten. The amount of food nutrients that are consumed by an individual from day to day varies

greatly. To obtain a true picture of the adequacy of a person's diet, it is necessary to have a record of the food consumed for several days.

By the use of the interview and food record techniques, the dietary habits of 75 expectant mothers have been studied at least for two and usually for three seven-day periods. The nutrients in the foods eaten have been calculated by the use of food value tables, and the adequacy of the dietaries evaluated by the use of the table of Recommended Daily Dietary Allowances set up by the Food and Nutrition Board of the National Research Council. These allowances for nutrients have been recommended as ideal levels at which to aim; but it does not necessarily mean that failure to attain these levels indicates a state of malnutrition. It has been found that only one woman of the 75 studied consumed a diet adequate in all nutrients as recommended for women in the latter half of pregnancy. Two other women met the recommended daily allowances in all nutrients except calcium. The majority of the diets were low in all or several of the eight nutrients studied. The number of diets meeting the recommended daily allowance for thiamine was 8 percent; iron, 14 percent; calcium, 16 percent; riboflavin, 18 percent; protein, 22 percent; niacin, 28 percent; ascorbic acid, 40 percent; and vitamin A, 68 percent. More of the diets were adequate in ascorbic acid and vitamin A value than in any of the other nutrients. A higher percentage of the diets was surprisingly inadequate in thiamine, iron, calcium, riboflavin, and protein. Many of the diets could have been brought up to the adequate level by the addition of milk and meat or other foods in small amounts; however, some of the diets were so grossly inadequate that drastic changes should have been made.

With the idea in mind that the adequacy of the mother's diet might be directly dependent upon the income of the family or more closely upon the amount spent for food per person by the family, a study was made of the adequacy of the mother's diet in relation to the amount of money expended for food. In the cases studied, no correlation existed between the adequacy of the mother's diet and the amount of money spent for food. This fact suggests that the education or interest of the homemaker in food nutrients and requirements rather than the amount of money available for food might be the determining factor in what she buys.

Blood and urine samples were taken from the women at different stages of pregnancy. This blood was analyzed for hemoglobin, ascorbic acid, carotene and vitamin A values.

A summary of the data indicates that the blood values of these nutrients for the majority of the women fall in either the medium or high range. The fact that a lesser number of women are in the high range for hemoglobin than for the other nutrients may be a reflection of the low dietary intake of protein and iron. As yet the data have not been analyzed to determine whether the women with the lowest intake of dietary nutrients are the women with the lowest value for the blood nutrients. Neither have the analytical data on the urinary excretion of nutrients been correlated with the dietary or blood data. Until these studies are completed it will not be possible to discuss these data in respect to the over-all nutritional status of the women.

The results of the physical examinations have not been summarized completely or correlated with the dietary or biochemical data. However,

it is evident that several of the women studied showed some clinical signs (usually to a slight degree) during pregnancy that might be attributed to an insufficient amount of some of the food nutrients in their diets. An evaluation of the significance of these findings must await completion of the study.

DEPARTMENT OF HORTICULTURE

Clark L. Thayer in Charge

Chemical Sprays Help Control Weeds in Nurseries. (C. J. Gilgut.)

In a comparison of various weed-killers for control of weeds in nurseries Sovasol No. 5 (Stoddard Solvent) gave more satisfactory results than dinitro or 2,4-D preparations. Weeds are killed better, especially grasses, and in greater variety, reducing considerably the amount of respraying necessary to control those that survived a previous spraying.

Chemical weed control does not replace cultivation between rows but it does reduce the amount of hand hoeing necessary in the row where weeds cannot be reached by horse or power cultivator. It is economically feasible, for in many instances weed control in the row has been accomplished at one-third the cost of hand hoeing. If applied while the weeds are still small, less than 4 inches high, the cost is still less because applications are made faster, weeds are killed better, and less material is used.

Seeds of the common weeds are not killed by thorough wetting with Sovasol No. 5, but germination is delayed, extending the time necessary between applications of weed killer and reappearance of weeds.

Unfortunately Sovasol No. 5 is not selective and will injure nursery plants, although some are more tolerant to small amounts than others. Coniferous plants, such as pines, spruces, junipers, and hemlocks, show only slight injury from drift or accidental light application. If the bark on the trunk at the base of these plants is soaked intentionally or through carelessness, or if the oil runs down the stem to the roots, invariably the plants are killed. Yews are highly susceptible to injury by the oil; leaves, stems, and even older bark at the base of the stem are easily injured and Sovasol used near them should be applied with great care. Leaves of deciduous plants are damaged easily and also the more tender, thin bark on twigs and stems; but the older, heavier bark is less easily injured.

Up to the present time, the best method of applying Sovasol to weeds in the nursery row is with a 3-gallon pump-up type sprayer equipped with about 5 feet of hose and a flat spray nozzle. This type of nozzle wets the weeds better than the conventional nozzle used for pest control, and spray application can be controlled better so that nursery plants are not wet. The height at which the nozzle is held from the ground determines the width of the band of spray applied: if needed, the width can be reduced to a narrow line. Where it is not feasible to spray weeds close to the plant because of danger of injury, the hoe has to be used. But where the oil is applied, the weeds are killed completely, even purslane which is difficult to control by hoeing. Since the soil is not disturbed, new weed seed is not turned up; in wet or heavy soil, weeds are killed and not replanted, as with hand hoeing.

DEPARTMENT OF OLERICULTURE

Clark L. Thayer in charge

Hormones on Trellis Tomatoes. (Robert E. Young, Waltham.) Some experimental workers have reported the advantage of using hormone sprays on field tomatoes to increase the set of fruit and hasten maturity. To determine the value of these hormones for growers of trellis tomatoes, para chlorophenoxyacetic acid was used at the rate of 30 parts per million. This was sprayed on the bottom cluster when three flowers were open. Treatment was repeated one week later. The results of this experiment have shown that in a cool year the hormone spray increased the number of flowers set as much as 40 percent. In a normal year the increase was only 6 percent, and in a warm year there was no increase. Maturity, however, was hastened by the hormone spray in all three years.

In 1950, a year in which there was no increase in the set of blossoms, the sprayed plants produced 385 baskets of tomatoes up to August 3, whereas the unsprayed plants produced only 213 baskets per acre. This hastening of maturity of the bottom cluster delayed the maturity of the second and third clusters somewhat but did not decrease the total yield.

This material is not too costly, and application does not require much labor. It should, however, be used with care, following the directions of the manufacturer.

Breeding Sweet Corn, Peppers, and Field Tomatoes for Massachusetts. (William H. Lachman.) Two sweet corn varieties, Pilgrim and Golden Jewel, released several years ago have become standard varieties for Massachusetts.

Gold Mine sweet corn was introduced recently to the trade and was well received where planted on fertile soil. Gold Mine has been in our trials for six years and has repeatedly matured earlier than all other commercial hybrids with which it has been compared. A new experimental hybrid tested this year, with a slightly better ear and stalk, matured one day earlier than Gold Mine.

Another new hybrid, Barbecue, in season with Pilgrim, has an exceptionally long, attractive ear of good quality and has yielded well in our tests. A considerable amount of seed was sent out to farmers for testing in 1951.

The main object of the breeding problem now is to incorporate higher quality into the early hybrids by using a glumeless type as well as a super-sugary type corn.

From hundreds of tomato crosses made in recent years one hybrid has performed very well in field trials. This variety is made by crossing Red Cloud to Pennheart. It has a determinate compact plant with clusters set very close together on the stem and combines the vigor and size of Pennheart with the smoothness of Red Cloud. This variety has consistently yielded more early fruit than any other variety in our trials. A number of seed samples were sent out for trial among farmers in 1951.

A further search for desirable early tomato hybrids is being made with the object of incorporating firmer fruit with less tendency to crack.

Weed Control in Vegetable Crops. (William H. Lachman.) Experiments involving chemicals for controlling weeds in sweet corn indicate that Granular Cyanamid, sodium pentachlorophenate, 2,4-D, and Premerge are adapted to this purpose in pre-emergence applications.

Granular Cyanamid at the rate of 400 pounds per acre applied one or two days before the corn plants emerge prevented growth of annual weeds for three to four weeks. Fifteen to twenty pounds of sodium pentachlorophenate per acre, one and one half pounds of 2,4-D (acid equivalent) and three to six pounds of DNOSBP in Premerge were all very effective in preventing annual weed growth in sweet corn when applied to the soil immediately after planting the seed.

Premerge and sodium pentachlorophenate were also effective in controlling weeds in snap beans.

Sodium pentachlorophenate at ten pounds per acre and Granular Cyanamid at 400 pounds per acre in pre-emergence applications appreciably reduced the stand and size of weeds in set onions.

Culture and Nutrition of Vegetables. (William H. Lachman.) Stokesdale tomatoes treated with Sure-Set (p-chloro phenoxyacetic acid) produced earlier and larger tomatoes than untreated plants. The open blossoms of the first two flower clusters were treated twice with this chemical with the aid of a nasal atomizer. Two pickings were made from the treated plants before any ripe fruit appeared on untreated plants.

Sweet Spanish onions grown from plants performed exceptionally well in our experiments, as well as in cooperative tests with farmers. Onion F_1 hybrids proved to be more uniform in size and shape than ordinary varieties, and two of these hybrids outyielded four commercial standard strains of Sweet Spanish onions.

Our experiments have shown that it may be possible for farmers to predict the harvest date of sweet corn at the time of planting since individual varieties apparently require a rather uniform amount of heat to bring them to maturity. Successive plantings of sweet corn require great differences in regard to days to ripen but require essentially the same number of heat units to reach maturity. These heat units are figured as daily temperatures in excess of 50° F. and are accumulated from the date of planting until harvest. When successive plantings are compared on this basis, early, midseason, and late plantings all require approximately the same number of heat units to ripen.

New Varieties of Broccoli[1]. (Robert E. Young.) Two new varieties of broccoli, Waltham No. 11 and Waltham No. 29, developed as a result of several years breeding work, have proven very desirable to market gardeners who have had them in large scale trials. Waltham No. 11 can be grown in the spring and also in the fall, but Waltham No. 29 must be grown as a fall crop.

The Waltham No. 11 is not distinctive as to type. It was bred to produce a large proportion of the crop at one time in order to reduce the cost of harvesting. Compared with other varieties, it is early when grown in the spring but only midseason when grown in the fall. In spring trials by market gardeners, and at the Waltham Field Station, this variety has produced a larger crop of marketable broccoli than any

of the other varieties tested. Much of this increase is due to the elimination of plants that produce either a poor head or no crop at all. The heads of Waltham No. 11 are medium large, dark green, with small buds that remain tight for several days.

The Waltham No. 29, which requires warm weather for its proper development, can be used only as a fall crop in Massachusetts. The plants are different from other varieties in that they are short and compact with many side shoots that develop just above the soil line. The plant and head are slow growing. Waltham No. 29 is not easily affected by periods of hot weather which occur in the fall, thus giving the grower an opportunity to let the heads develop fully without danger of losing them because of opening buds. This variety produces a very large head with many heavy stems under the buds, which gives the grower a larger crop and the consumer a higher quality product. This is also a desirable character for the freezer since most of the head, when cut to a 6-inch length, comes apart in many of the smaller heads of freezing size. Waltham No. 29 broccoli is much more uniform in type than Waltham No. 11 and other varieties. It produces 10 to 20 percent larger crop, much of which comes on the large number of side shoots. It also has more cold resistance.

Several hundred acres of each of these varieties are being grown in 1951 on both the East and West Coast. Waltham No. 29 seems to have the widest adaptability. Large-seed growers have been supplied with stock seed.

Transplanting Lettuce. (Robert E. Young, Waltham.) Pennlake lettuce will not produce satisfactory heads if planted too deeply. This was proved in two-year trials of transplanted lettuce. When planted too deeply, the plants and heads are very small, and the heads cone-shaped. Some commercial lettuce fields have contained as many as 50 percent of this type of plant, and other fields almost none.

It was found that Pennlake lettuce was much more sensitive to deep planting than Great Lakes. Deep planting caused the heads to mature earlier and so they were too small for marketing.

Trials were also conducted, putting the plants on a small ridge. This caused the plants to be larger than those set on level soil at the regular depth, and they matured later.

Those growers using Pennlake for the lettuce crop transplanted in the field should be sure that the workers do not set the plants too deeply, but at the same depth that they were growing in the flat where they were started.

The Degree of Maturity of Sweet Corn. (W. Bradford Johnson and Emmett Bennett.) The degree of maturity of sweet corn can be estimated by several methods. One method recently developed at this station is based on the light scattering effect of the components of the kernel when blended and suspended in water. The procedure is highly sensitive, reproducible, and quick. The degree of maturity is evaluated on a relative basis by means of a turbidity index. This factor is obtained by multiplying the percentage of light transmission of the aqueous sus-

1 The assistance of William Richards, Forestdale, Massachusetts, in the development of these varieties is acknowledged and appreciated.

pension by the amount of dry matter in the sample. The suspension from the more immature sample will contain a greater amount of soluble material and a lesser amount of the relatively insoluble polysaccharide; it will, therefore, transmit a greater percentage of the incident light. In the mature sample the opposite is true, and hence less light will be transmitted through the medium. Varying degrees of maturity will fall within these extremes.

DEPARTMENT OF POMOLOGY
A. P. French in Charge

McIntosh "Bud Sports." (W. D. Weeks, F. W. Southwick.) One of the problems confronting the fruit grower in the production of McIntosh apples is the failure of many McIntosh trees to produce highly-colored apples which have an over-all red color. Many orchards contain trees that produce poorly colored apples on which the red color is striped. In an attempt to overcome this difficulty, red "bud sports" or strains have been selected and propagated to produce apples that are superior in amount and type of red color.

In the Spring of 1942, an orchard containing six "bud sports" or strains and the so-called standard or striped McIntosh was planted to determine whether there were superior strains of McIntosh with regard to red color development. This orchard has fruited sufficiently for the past three years to determine the performance of the strains. Rogers McIntosh continues to be the outstanding strain because it produces 40 percent more fancy fruit than the regular or striped McIntosh. The crop from the Rogers strain graded out 97 percent U. S. Fancy, whereas the crop from the regular McIntosh graded only 58 percent U. S. Fancy.

Some of the other red strains had redder apples than the regular McIntosh but they all produced some striped apples, whereas the fruit from the Rogers strain was all of the solid red type.

No other differences have developed among the strains to date, but the test will be carried on for a few more years to determine whether the strains have other desirable characters and whether the Rogers strain continues to maintain its superior red color.

The Nutrition of Apple Trees. (W. D. Weeks, F. W. Southwick, Mack Drake, and J. E. Steckel.) The effect of different rates and sources of nitrogen on fruit color and the chemical composition of the foliage of seventeen-year-old McIntosh apple trees has revealed some interesting relationships. Trees that received annual applications of 4 and 6 pounds of ammonium nitrate per tree produced fruit of very low red color. Only 18 to 20 percent of the crop graded U. S. Fancy. In contrast, trees that received equivalent amounts of nitrogen in the form of hay mulch produced exceptionally highly colored apples—85 to 90 percent of the crop graded U. S. Fancy. The fruit from trees receiving equivalent nitrogen in the form of complete fertilizer (7-7-7) was intermediate in red color. Trees receiving 20 pounds of complete fertilizer (7-7-7) plus 2 pounds of ammonium nitrate produced fruit that was slightly better colored than that from trees which received 6 pounds of ammonium nitrate.

The color of the fruit from trees receiving nitrogen as spray urea was disappointingly low. Only 46 percent of the crop graded U. S. Fancy.

Determinations of the chemical composition of the foliage from the trees receiving the several treatments revealed that ammonium nitrate increased leaf nitrogen and magnesium and depressed potassium and phosphorus. Hay mulch increased potassium and phosphorus, but depressed nitrogen. Magnesium remained about the same as it was before the treatment was started. Complete fertilizer failed to increase potassium and phosphorus content of the foliage to the same exent as hay mulch.

A definite relationship was established between leaf nitrogen and potassium. As nitrogen increased, potassium decreased. The relationship of leaf nitrogen and potassium to red color development of the fruit showed that as nitrogen increased, red color decreased, whereas an increase in leaf potassium was associated with highly colored fruit. These data suggest that red color development may be partially dependent upon the relative amounts of nitrogen and potassium found in the foliage.

Crop yields have not been materially influenced by the different treatments as yet. The ammonium nitrate plots have had the highest yields.

To determine what effect the competition for plant nutrients by the grass growing under the trees might have with tree performance, grass samples were obtained, and the amount of dry hay per acre was calculated for the different treatments. The greatest amount of grass (3400 pounds dry hay per acre) was found in the plots that received complete fertilizer plus ammonium nitrate. Trees that received 6 pounds of ammonium nitrate had the next highest amount of grass (2700 pounds of dry hay per acre) growing under them. The hay mulch plots had the least amount of grass (200 to 600 pounds dry hay per acre) although the urea sprayed plots were not much better. The greater amount of grass growing under the trees that received both complete fertilizer and ammonium nitrate may help to account for the lower leaf nitrogen and somewhat better fruit color that these trees had in comparison with the ammonium nitrate trees. The lack of grass competition under the mulch trees may account for part of their differences in leaf nitrogen and fruit color which they exhibited in contrast to the performance of trees which had greater competition from grass for plant nutrients.

Weed Control in Lowbush Blueberries. (J. S. Bailey and W. D. Weeks.) The growing of lowbush blueberries is an important industry in Massachusetts. In the two towns of Granville and Blandford alone there are 1500 acres with an annual crop valued close to $100,000.

These blueberry fields require periodic burning to maintain production. Over a period of years this burning lowers soil fertility with consequent reduction in yield. The use of fertilizer to replace lost fertility has not been entirely successful. One reason is that the fertilizer sometimes stimulates weed plants as much or more than the blueberries.

In a blueberry field any plant not a blueberry is a weed. Thus there is a wide variety of weeds to be controlled: grasses, ferns, low growing shrubs, such as bayberry and laurel, and the sprouts from the stumps of trees like maple, oak, and birch.

Although some weed plants are controlled by cutting and burning, many are not. The use of chemicals for the control of the latter looks

promising. Consequently, a search is being made for chemicals which will kill the weed plants with little or no injury to the blueberries.

Gray birch, when cut, will sprout freely from the stumps. This habit makes it a serious pest in many blueberry fields. It is fortunate that gray birch is quite sensitive to the new weed killer 2,4,5-T, a close relative of 2,4-D. In fact, where these two are combined, as in the so-called "Brush Killers," the mixture appears to be more effective against gray birch than the 2,4,5-T alone. Since this mixture at lethal concentration is also toxic to the blueberries, its successful use depends on the way it is applied. The "dormant basal stem" treatment has been found to be very effective. The brush killer mixed with oil (kerosene, Diesel or fuel oil) at the rate of 4 percent by volume, roughly a pint to 3 gallons of oil, is applied during the dormant season to the sprouts from their base up to knee height. Low pressure and a nozzle delivering a narrow fan-shaped spray are desirable. A knapsack spray is satisfactory for this type of work. The lower parts of sprouts and the old stumps should be thoroughly covered, but the blueberries should be sprayed as little as possible.

Sweet fern has grown up so thick in some blueberry fields that it has ruined the production. This weed is easily controlled with 2,4-D. A solution made by adding one pound of sodium salt or 26 ounces of an amine formula (containing 4 pounds 2,4-D acid equivalent per gallon) to 200 gallons of water sprayed evenly over an acre will give almost complete control.

Patches of bayberry often become troublesome in blueberry fields. This is another weed which can be controlled with 2,4,5-T. To avoid injury to blueberries a weak solution must be used. Twenty-six ounces of a 2,4,5-T formula containing 4 pounds acid equivalent per gallon gives a solution containing about 500 ppm. This is sprayed on the bayberries in June or July. Enough is applied to wet the leaves thoroughly without dripping. This first spray will kill the tops to the ground. There will be some resprouting the following year; however, spray on these sprouts will complete the kill of the entire plant.

The Correction of Magnesium Deficiency in Cultivated Blueberries. (John S. Bailey and Mack Drake.) Magnesium is one of the elements which plants must get from the soil for normal growth and development. Without magnesium, plants are unable to make green coloring matter, chlorophyll, so vital to their life and health.

Some of the soils of Massachusetts are low enough in magnesium so that plants that have a high requirement for this element will show a deficiency. Among fruit plants, numerous cases of magnesium deficiency in apples have been reported in Massachusetts. The first case of magnesium deficiency in cultivated blueberries in the State was found in the Summer of 1949 in a planting of young bushes in Middleboro. The leaves on affected bushes turned yellow and red between the veins. This discoloration started at the leaf tip and spread along the margins toward the base. Chemical analyses of the leaves verified the visual diagnosis. The average magnesium content of the leaves on a dry weight basis was 0.049 percent. In one sample the magnesium content was 0.030 percent. Even 0.049 percent is extremely low. Also, the soil was found to be extremely acid, pH 3.8 to 4.2.

To overcome this deficiency two of the materials most commonly used for this purpose, Epsom salts and dolomitic limestone, were tried. Varying amounts of each material were applied to the soil and cultivated in. A year later chemical analyses of the leaves showed that both sources of magnesium increased the magnesium content of the leaves.

When Epsom salts was used, increasing the MgO applied from 25 lbs. per acre to 150 lbs. per acre resulted in a steady but not proportional increase in leaf magnesium content. When dolomitic limestone was used, 100 lbs. of MgO per acre was about as effective as 200, 400 or 600 lbs. per acre. One hundred to 200 lbs. of MgO as dolomitic limestone was slightly more effective than 25 or 50 lbs. of MgO as Epsom salts.

Where magnesium deficiency appears in cultivated blueberries, a single application of magnesium at the rate of 100 lbs. of MgO per acre should correct the trouble. Either 500 lbs. of dolomitic limestone (20 percent MgO) or 600 pounds of Epsom salts gives the required amount.

The use of dolomitic limestone to supply magnesium also causes an increase in soil pH. With cultivated blueberries this is not objectionable so long as the pH does not increase much above 5. In this experiment 2,000 lbs. of lime per acre supplying 400 lbs. of MgO increased the pH to just about 5 during the first year. This suggests that for this soil one ton of dolomitic lime per acre is the maximum that should be applied.

Post-calyx Chemical Thinning of Apple Trees Shows Sufficient Promise for Commercial Usage. (F. W. Southwick and W. D. Weeks.) In 1948, following a rainy, cool bloom period which restricted bee flight and hence pollination and fruit set, attempts were made to thin apples from 2 to 4 weeks after calyx when the need for thinning sprays could be much more accurately determined than at either blossom or calyx time. Further results obtained in 1949 and 1950 with spray applications made from 10 days to 3 weeks after calyx have been sufficiently promising to warrant commercial usage of this method for thinning. It has been possible by one application of naphthaleneacetic acid after calyx to thin such varieties as Wealthy, Early McIntosh, Baldwin, Red Gravenstein, Kendall, and others in a fraction of the time it could have been accomplished by hand and with less risk of overthinning and foliage injury than could be accomplished by dinitro materials at blossom time or naphthaleneacetic acid at calyx time. Early thinning has resulted in an increase in "marketable" yield (volume of fruit over 2½" in diameter) as compared with unthinned trees. Also, such varieties as Golden Delicious, Wealthy, Opalescent and Red Gravenstein, can be induced to yield annual crops when adequately chemically thinned after calyx. Even such biennial bearers as Early McIntosh and Baldwin have occasionally blossomed in successive years in some orchards following this thinning procedure. However, the factors which influence the degree of abscission following the use of naphthaleneacetic acid are not sufficiently well understood. We are hopeful that as experiments continue and our experience increases we can forecast more accurately the degree of thinning which will result under a given set of conditions. Until then, the possibility of occasionally overthinning with this chemical will be present.

The Use of Activated Carbon in Apple Cold Storages Has Increased the Marketable Life of Apples. (F. W. Southwick.) Tests during the past two years have shown that activated coconut shell carbon, either in manufactured units or in suitably designed "home-made" purifiers, will add approximately one month to the storage life of McIntosh and Cortland as determined by firmness of flesh. This is assuming adequate carbon is used, air flow through the carbon is sufficient, and that adequate air distribution exists throughout the room. Under the conditions mentioned various storage odors arising from boxes, the apples themselves, and from other produce have been markedly reduced in most cases. This ability of carbon to eliminate odors has resulted in apples which are free from storage "off" flavors and, thereby, more palatable to the consumer. However, air purifiers employing coconut shell carbon have not given adequate control of storage scald. In fact, for the variety Cortland, air purification with carbon appears to be inferior to shredded oiled paper in this regard.

It is anticipated that following another year of experimentation with "home-made" units designs of 2 or 3 types will be made available for installation in rooms with small, ceiling hung cooling units as well as with the larger floor mounted cold diffusers. It is expected that these "home-made" types can be built at a cost considerably below manufactured units now on the market.

DEPARTMENT OF POULTRY HUSBANDRY

Fred P. Jeffrey in Charge

A New Type of Sex Linkage in the Domestic Fowl. (F. P. Jeffrey.) Dominant White Plymouth Rock females of the University of Massachusetts strain when mated with Rhode Island Red or New Hampshire males produce chicks that can be identified on the basis of down color with 100 percent accuracy at hatching time. Male chicks are white, and females are light tan or buff. At maturity the males are generally white, and the females are buff or red on the surface and pure white in undercolor. This is the first record of sex determination at hatching on the basis of down color in which the gene for dominant white is involved. Genetically these dominant White Plymouth Rock females carry genes for silver, gold intensifier, and dominant white. Rhode Island Red or New Hampshire males carry genes for gold, gold intensifier, and lack the gene for dominant white.

Broodiness May Be Completely Eliminated in Rhode Island Reds. (F. A. Hays.) The broody instinct reduces annual egg production because each broody period is generally associated with about 15 days of non-production. Through selective breeding it has been possible to decrease the incidence of broody birds in our Rhode Island Red flock from about 90 percent to as low as 3 percent. By use of the progeny test combined with hormone tests for carriers of the broody inheritance a line has been developed that exhibits no broodiness in the first laying year. We are now in the third generation of this line in which no broody birds have

appeared. Such stocks are particularly useful in breed or strain crosses where the increased incidence of broodiness has made such crosses undesirable.

Fertility in Poultry is a Highly Variable Character. (F. A. Hays.) In pedigreed Rhode Island Reds bred for high fecundity, fertility behaves in a variable fashion. Normally the degree of fertility increases as the season advances from February to April. In pedigreed pen matings a decline in fertility is often observed in successive weeks. Our results indicate that this decline is generally the result of failure of some birds to mate regularly through the breeding season; this can usually be corrected by changing males. Cases have been observed, however, where low fertility resulted not from failure to mate but to incompatability of male and female germ cells. Our data rather definitely indicate that fertility is regulated in part by inheritance.

Hatchability has a Strong Genetic Basis. (F. A. Hays.) Through selective breeding it has been possible to develop two lines of Rhode Island Reds that differ greatly in the percentage of their fertile eggs that hatch. The high line has a mean above 80 percent, and the low line has a mean below 50 percent. The problem now is to discover some of the specific causes of this very low hatchability under good feeding, management, and incubation.

Breeding for High Fecundity Discloses Many Valuable Facts. (F. A. Hays.) Winter pause and winter rate of laying have been shown to be intimately related. Birds laying at a slow rate are very likely to stop laying for a time during the winter months, whereas those that lay at a very high rate have very little winter pause. Shell color in Rhode Island Red eggs normally increase between the spring of the first and second laying years. Rapid chick feathering produced by autosomal genes is associated with more rapid early weight increase, but the sex-linked gene has no effect on early growth. Very early sexual maturity in Rhode Island Reds is associated with more rapid chick growth. Hens that lay 300 eggs or more are definitely superior breeders to their full sisters that lay fewer eggs. Considerable success may be expected in selecting superior males on the ability of their daughters to lay at a high rate either in November at the beginning of the year or in August at the close of the year. Trapnesting is required for both periods because some males will be selected because of superior November intensity alone, whereas others are selected on the basis of August intensity alone. Seldom will a male qualify in both categories.

Photograph of Massachusetts Rose. (F. A. Hays.) Massachusetts Rose, a Rhode Island Red hen hatched in 1944, is remarkable for her sustained high egg production and for her ability to transmit high production when mated to three different males. A member of the high-producing Massachusetts Experiment Station flock, she has laid 1079 eggs in four years, setting a mark of 330 in her first year and dropping only to 236 in her fourth year.

Her March egg weights have varied from 24.7 ounces per dozen to 26.7; their hatchability ranged from a low of 76 percent her first year to a high of 91 percent her second year. The fourth year it was 86 percent.

Rose had 7 daughters that averaged 245 eggs in 1945. From another sire, she had six daughters that averaged 244 eggs in 1946. In 1947, from a third sire, she had five daughters that averaged 243 eggs plus.

She lays a medium brown egg with good shape and shell texture. A medium red herself, she weighed 5.35 pounds at first egg and now weighs 7½ pounds.

One of a family of 13 sisters who averaged 239 eggs, Rose had one sister who hit 303. Her sire had 23 daughters with an average of 243, and his ten sisters averaged 249 eggs.

Inheritance of the Length of the Incubation Period of Chickens. (J. R. Smyth, Jr.) After only one generation of selection, lines differing in regard to the length of the incubation period have been separated. The early hatching line emerged at an average of 20 days and 22.3 hours after the beginning of incubation, and the late hatching line took an average of 21 days and 5.7 hours to complete the incubation period. This difference indicates that the heritability of the length of the incubation period is high in comparison with egg production and many other characters of economic importance. Observations were also made on the effect of the length of incubation period on subsequent growth rate to 8 weeks of age, mortality, and sex of the chicks. The only significant difference was found in the case of post-hatching mortality. The chicks from the early hatching line had a mortality of only 3.03 percent to 8 weeks of age, as compared with a mortality of 10.53 percent for the chicks from the late hatching line. Most of this mortality occurred during the first 10 days following hatching.

Mating Frequency in Turkeys. (J. R. Smyth, Jr.) Observations were made of the number of times Jersey Buff turkey hens mated during the first 13 weeks of the 1951 mating season. These observations were made by allowing the toms to be with the hens for a one-half hour period on each of six days per week. In the turkey, the female determines whether a mating will be attempted or not. If a female dropped to the floor and permitted the male to mount her, she was given credit for a mating. This eliminated any differences in the mating efficiencies of different males.

The average number of matings per hen was 9.2 during the 13 week observation period. There was considerable variation between females with 28 matings being the individual high record and zero being the low extreme.

A definite correlation between the number of matings and fertility was observed. Turkey hens mating 1 to 6 times during the period produced 82.9 percent fertile eggs. Those hens mating from 7 to 12 times gave a fertility of 96.1 percent, and those mating more than 12 times produced eggs that were 96.6 percent fertile. One hen in the highest frequency group mated only during two concentrated periods and produced a number of infertile eggs just prior to the second mating spree. If her record were eliminated, the fertility of the highest frequency

group would have been raised to above the 99 percent level. This illustrates the point that the distribution of matings is as important as is the total number. Where a hen mated at least once every 3 weeks, fertility remained at a very high level.

Length of Life of Turkey Sperm in the Female Reproductive Tract. (J. R. Smyth, Jr.) The length of time that sperm cells of the turkey tom can survive and fertilize eggs after a single mating is important for several reasons. For one thing, it determines the frequency of natural matings, which is necessary to maintain a high level of fertility. Sperm survival time is also important to those who practice artificial insemination because it determines the best interval between inseminations of the turkey hens. By pedigreeing eggs on a basis of both the dam and the days after an insemination, it is possible to study this subject.

During the past year a study of the Station Jersey Buff flock showed that the average duration of fertility following an insemination was 47.5 days. However, ferility is not maintained at a high level throughout this period. For the first 30 days following the day after insemination, 96.1 percent of 466 eggs laid were fertile. However, during the period from 30 to 40 days following insemination the fertility of 126 eggs laid dropped to 80.8 percent. After 40 days the fertility dropped off to a very low level. These data indicate that if a turkey hen is inseminated at 4-week intervals a very high level of fertility should be expected.

The percent hatch of fertile eggs was also found to remain at a satisfactory level for the 30-day period following insemination. There was an increase in the number of fertile eggs that failed to hatch after this time. This indicates that, in the turkey, old or "stale" sperm cells cause an increase in the incidence of dead embryos.

DEPARTMENT OF SEED CONTROL
Frederick A. McLaughlin in Charge

Enforcement of the Seed Law, together with the desire of seedsmen to comply with requirements of this Act, and a growing interest of the public in good seed, have greatly increased the number of service samples sent to the Seed Laboratory for testing. From July 1, 1950, to June 30, 1951, 6137 service and inspection samples of seed were received and tested in the laboratory. The laboratory also received and cleaned 67 lots of tobacco seed.

Analysis of inspection samples indicates that most seedsmen have complied with label requirements of the Seed Law. A large part of the violations found are technical rather than flagrant in nature.

Operation of the Seed Law is reported in an annual control series bulletin issued for that purpose.

DEPARTMENT OF SHADE TREE LABORATORIES
Malcolm A. McKenzie in Charge

During the past year, numerous inquiries were received concerning a disease known as oak wilt which has been reported on native oaks in the Midwest and as far east as central Pennsylvania. A fungus, *Chalara quercina* is reported as the causal organism. Dying oaks have been found in all parts of Massachusetts, but the oak wilt fungus was not present in any of the oak material tested, and typical symptoms of the disease were lacking.

The disease of maples in which bronzed flags develop from foliage was not so much in evidence during the past year as in some previous years.

A disease of mockorange (*Philadelphus* spp.) continues to attract wide attention throughout Massachusetts. The disease is characterized by unsightly dead stalks which may be removed by pruning. Older shrubs can stand pruning of all affected stalks without being seriously disfigured. A fungus was found on the bark of dead stalks, but proof of its pathogenicity is lacking.

Numerous fungi were isolated from elms, but aside from the Dutch elm disease fungus (*Ceratostomella ulmi*), *Verticillium* sp. and *Cephalosporium* sp. were most common. Both of these fungi cause wilt diseases.

Other tree troubles diagnosed by field inspection or by laboratory culture and examination included the following uncommon and interesting diseases or fungus organisms:

On Catalpa — Verticillium wilt.

On Sugarmaple — *Steganosporium* sp. isolated from several maples probably weakened by drought.

On Elm — Several isolations of *Acrostalagamus* sp. and *Sporotrichum* sp. from twig samples tested for Dutch elm disease.

On Birch — *Coryneum disciforme* isolated from wilted branches of gray birch.

On Butternut — *Melanconis juglandis* associated with dieback of twigs and branches.

Rapid developments in the field of herbicides have encouraged widespread programs for the eradication of noxious plants, especially poison ivy at the base of trees and along highways. During the past two years vegetable crops in adjacent fields were seriously damaged because of the presence of a highly volatile ester in the herbicide. Herbicides should be selected carefully, therefore, to avoid a highly volatile ester in favor of a low volatile ester. In this way, the herbicide material will not be carried so readily in air currents over the surface of the ground into areas out of bounds for treatment.

The Dutch Elm Disease. (M. A. McKenzie, D. H. Marsden, W. E. Tomlinson, Jr., P. L. Rusden, R. L. Coffin, J. G. Moline.) From July 1, 1950 to June 30, 1951, the Dutch elm disease was found in 27 additional towns, making a cumulative total of 210 since the disease was first known here (1941, Alford, Berkshire County). In laboratory studies, by means of tissue plantings in artificial culture media, the disease fungus, *Ceratostomella ulmi* (Schwarz) Buisman, has been isolated from 8996 trees in 11 of the 12 counties on the mainland; Barnstable, Dukes, and Nantucket were reported as disease-free at present.

With present knowledge, practical restriction of Dutch elm disease rests principally upon (1) early discovery of diseased trees and prompt action in their removal and burning, and (2) a general sanitation program to eliminate elm bark beetles, the principal vectors of the disease fungus. In fact, research indicates also that the greatest handicap in control is delay in applying practices of sanitation. Therefore, delay in detecting diseased trees is a serious blow to reasonable control.

Better methods of control await further research which is now stymied and lapsed through lack of funds. On the basis of limited studies, the serious interruption of research on pruning diseased trees had delayed development of techniques and procedures which, if ready for application now, might save cities and towns thousands of dollars annually and hundreds of elm trees.

Likewise, on the basis of research there is every reason to believe that restriction or practical control of Dutch elm is possible in every community. The immediate cost is more reasonable than the postponed cost would be, but disease restriction requires action in detecting and removing, timed properly and not at the convenience of other work. This applies equally whether there is an accumulation of diseased trees or a new outbreak of the disease. This compulsion feature of control is, of course, unpopular and therefore delay may be expected in acceptance of it. But spread of the disease is uncompromising, and limited funds apparently saved in short-sighted economy will be required many times over for removal of dead trees, which become hazards to life and property, at a time when removal contributes in no way to disease control.

The Pruning of Elms Affected with Dutch Elm Disease. (D. H. Marsden.) The efficacy of pruning as a method of saving elms infected with Dutch elm disease was tested on a small scale in the Summer of 1950. In a scouting program, elms having only a small amount of wilt were pruned back severely at time of discovery, or at most within 24 hours. The proximal limits of discoloration in the pruned branches were determined for record, and tissue plantings from affected twigs were made in artificial culture media to determine the cause of the wilt in each case.

Twenty-one elms were operated on in this manner. Of these, 16 were infected with the Dutch elm disease fungus, *Ceratostomella ulmi*, two with *Cephalosporium* sp., one with *Verticillium* sp., one with bacteria, and one yielded no organism in culture. Two of the trees with Dutch elm disease were subsequently removed when further wilting occurred throughout the crown. On June 6, 1951, no further spread of the disease was apparent in 12 of the trees affected by Dutch elm disease. The remaining two trees were not observed.

The pruning experiment is being continued in 1951 with the tree wardens of several towns cooperating. It is already apparent that early detection of disease symptoms and prompt pruning out of affected parts of trees are essential if a diseased tree is to be saved. Spread of the infection to the trunk of a tree and thence to other parts of the crown precludes eradicaion of the disease by pruning.

The Toxicity of Various Tree Wound Dressings to the Dutch Elm Disease Fungus. (D. H. Marsden.) A number of proprietary compounds used commonly as tree wound dressings were tested to determine their toxic effect on the spores of the Dutch elm disease fungus, *Ceratostomella ulmi*. It was found that white lead paint, spar varnish, a penetrating wood-sealing compound, asphaltum, and asphalt-base tree wound paints failed to kill the spores of *C. ulmi* during periods of contact ranging from 1 to 11 days. White shellac, Bordeaux paint, a natural latex compound, and tree wound paints containing wood creosote oils killed the fungus spores after one-day contact. Also, the addition of 25 percent by volume of shellac to the nontoxic paints rendered them toxic to *C. ulmi* spores. Thus the possibility of the inoculation of elms with *C. ulmi* through wound dressings was verified, although no actual occurrence of disease spread in this manner has been found in trees.

Wind- and Ice-Storm-Damage to Trees in 1950. (M. A. McKenzie.) The early reports of the Massachusetts Agricultural Experiment Station and many other publications devoted extensive space to the subject of damage to trees from ice storms. The damage is often picturesque, spectacular, and expensive.

In the Connecticut Valley in Massachusetts, the windstorm of November 25 and the ice storm of December 29 afforded a rare opportunity to observe ice damage almost simultaneously with wind damage in the same plantation of trees. At the University, in the experimental plantation of elms about 20 years old, the fury of the windstorm shattered trees of a certain species of elm rendering them apparently unsuited for further research work. After clearing the plot, however, there was hope that individual trees of the species might be salvaged. This particular hope was short-lived because the ice storm wrought added havoc on remaining similar trees.

The most interesting observation was that *Ulmus pumila*, a rapid growing species of elm, somewhat resistant to Dutch elm disease, was most severely damaged by wind and ice.

Wood of this particular tree is characteristically more brittle than that of most elms. In contrast to many trees, the brittle branches snap readily instead of swaying or drooping. Apparently, the brittle character of the wood is the decisive one when this tree is exposed to either wind or ice. A live twig of American elm (*Ulmus americana*), for example, will withstand excessive bending, whereas one of *U. pumila* snaps.

This report is not intended to eliminate *U. pumila* from appropriate planting. Certain features of the experimental plot are not prevalent under all conditions. But where brittleness of the species might cause damage, selection of other trees may be a wiser choice for planting.

DEPARTMENT OF VETERINARY SCIENCE
K. L. Bullis in Charge

Poultry Disease Control Service. (H. Van Roekel, G. H. Snoeyenbos, G. P. Faddoul, O. S. Flint, M. K. Clarke, O. M. Olesiuk, C. D. Brandt, B. A. Bachman, G. W. Fellows, and H. A. Peck.)

Pullorum Disease Eradication. Pullorum disease testing continues to be of great value to the Massachusetts poultry industry. During the 1950 and 1951 testing season a total of 556 chicken, turkey, and pheasant flocks were tested. The number of samples tested was 1,427,691 (1,394,192 from chickens and 33,499 from fowl other than chickens). The percentage of positive tests among chicken samples, representing 98.57 percent of all chickens tested, was 0.05. The percentage of "breaks" was 1.57. A total of 442 nonreacting chicken flocks was identified. Only six flocks were classified as positive at the end of the season.

The establishment and maintenance of pullorum-free flocks through effective testing and preventive measures have enabled flock owners to reduce the losses from pullorum disease to a minimum.

Salmonella Pullorum Studies. A nationwide survey of antigenic forms of *S. pullorum* was conducted for the purpose of securing antigenically complete forms which could be used for producing a superior testing antigen. Such a strain was found which, so far as is known, exhibits all the anticipated antigenic characteristics. Work is being continued to evaluate this antigen further.

This survey also indicated the relative incidence of variant forms of pullorum in the different states. A very wide variation of incidence was found. This incidence appeared to be closely associated with the efficiency of control methods used in each state. It was previously thought that the whole blood test was of primary importance in allowing the development of variant infection. Our results indicate rather, that multiple factors associated with control methods are of great importance in controlling variant infection.

Diagnostic Service. In the control and prevention of poultry diseases the diagnostic service is of inestimable value to the poultry industry in Massachusetts. Two laboratories located at Amherst and Waltham, respectively, are in operation in the state. Through their facilities the causes of the disease losses have been identified, enabling the flock owner to institute effective corrective measures.

During the 1950 calendar year, 6,410 specimens were received in 1,269 consignments of which 935 were delivered to the Amherst laboratory in person. The specimens included 5,945 chickens, 308 turkeys, 27 eggs, 19 canine feces, 17 chinchillas, 14 swine, 11 each of pigeons and pheasants, 10 each of bovine and mink, 5 rabbits, 4 each of canaries, ducks and sheep, 3 each of bovine feces, deer fetuses, geese and ruffed grouse, 2 each of dogs and foxes, and 1 each of goat, muskrat, quail, swan and woodcock.

Respiratory infections, discussed in another section, represented the most common diagnoses in chickens. Fowl paralysis (115), coccidiosis (89), keratoconjunctivitis (39), epidemic tremor (27) and so-called blue comb (27) represented other frequent diagnoses. Fowl cholera was diagnosed in 18 and fowl typhoid in 14 cases. The incidence of both

diseases was lower than in 1949, but that of fowl typhoid was significantly lower. Neither of the two most severely affected communities in 1949 had outbreaks in 1950. Avian tuberculosis was identified in 3 flocks.

Pullorum disease (2) and paratyphoid (1) continued to be uncommon diagnoses among turkeys. Fowl cholera (4) and swine erysipelas (3) appeared to be continuing as important problems. An outbreak that appeared to be typical nutritional encephalomalacia, as observed in chicks, was seen for the first time in poults. *Diplococcium* sp., identified by the Communicable Disease Center, Chamblee, Georgia, was recovered from the cerebellums of one lot of poults showing symptoms of a nervous disorder.

The Waltham Laboratory was officially opened for service on October 2, 1950. During the last three months of the calendar year of 1950, 1,295 specimens were received in 243 consignments of which 241 were delivered in person. The specimens included 1,239 chickens, 54 turkeys, and 1 each of geese and chinchilla. Lymphocytoma (35), capillariasis (29), Newcastle disease (16), ascariasis (16), and fowl paralysis (13) were the five chicken diseases encountered most frequently. Respiratory infections were also observed frequently among the cases submitted.

Infectious Bronchitis Control. Respiratory infections are of great economic concern to the Massachusetts poultry industry. A concerted effort has been made to reduce the losses from infectious bronchitis through an immunization program. During 1950, a total of 1,103 flocks was enrolled in the bronchitis control program. In general, the results have been very satisfactory in preventing natural outbreaks of the disease in immunized flocks. Modifications in the method of production have facilitated greatly the yield of the virus and improved the quality of the immunizing agent. This program has permitted flock owners to control infectious bronchitis thus preventing serious losses from the disease.

A total of 96 cases of respiratory disease was subjected to virus isolation by the embryo method. The following viruses were isolated: Newcastle disease 21; infectious bronchitis 18, of which 4 represented "breaks" following inoculation; 3 represented flocks manifesting a prolonged course of symptoms following inoculation, and in 1 both Newcastle disease and infectious bronchitis viruses were isolated; chronic respiratory disease agent, 20; infectious sinusitis agent, 2 turkey flocks; and laryngotracheitis, 1. Virus was not isolated from 35 cases, 13 of which were suspicious of being chronic respiratory disease.

During 1950, a total of 255 flocks was tested for infectious bronchitis. The diagnoses for the flocks were as follows: 202 immune, 20 susceptible, 15 questionable, and 15 had both susceptible and immune birds on the premises. Using the hemagglutination-inhibition test, 504 flocks were tested for Newcastle disease. The results were as follows: 200 immune, 229 susceptible, 7 questionable, and 68 had both susceptible and immune birds on the premises.

Immunity Studies on Newcastle Disease. (S. B. Hitchner, G. Reising and H. Van Roekel.) Previous studies on the effectiveness of vaccines in protecting chickens against Newcastle disease have indicated all vaccines to date have their limitations in insuring positive protection

against the disease. Investigations are being carried out to determine the factors which influence the effectiveness of the various vaccines, and to study methods by which the efficiency of vaccination against Newcastle disease may be increased.

The greater portion of these studies have dealt with the intranasal vaccine which is primarily used in the vaccination of baby chicks. Because of the low virulence of the virus used in this vaccine, it has been found that to protect the chicks each chick must receive many times the number of virus particles which it takes to infect an embryonating egg. Since the disease does not readily spread from chick to chick, careful administration of the vaccine to each chick is necessary to give protection.

Investigation of the outbreaks of Newcastle disease among vaccinated flocks and studies on the virus strains isolated from such outbreaks have not revealed any variant strains which differ antigenically from the intranasal vaccine strain. Therefore, the evidence would indicate incomplete flock immunity as the cause of outbreaks in vaccinated flocks, rather than new field strains of virus against which the intranasal vaccine will not protect.

Tests are under way to explore the possibility of immunizing chicks by spraying them with the same virus currently used in the intranasal vaccine. This method of application does not appear applicable in day-old chicks because it causes too severe a reaction. Results have been very favorable, however, in birds four weeks of age or older. Vaccination by atomization is done in the houses and thereby eliminates the labor of catching the birds and handling them individually. The immunity reactions in the flocks vaccinated by this method are being followed, and, if the results continue as favorably as in the past, there is a possibility that this method can be used for initial flock vaccination and revaccination to maintain the flock immunity at a higher level than has been possible in the past.

Mastitis Testing Laboratory. (W. K. Harris and I. M. Reynolds.) During the fiscal year of 1950 to 1951, a total of 37,580 milk samples was tested. Of this number, 19,223 were from 21 State Institution herds, 1,178 from the University Farm Department herd, and 17,179 from 182 private herds. Included in the latter were 307 samples from two county agricultural school herds, 15 from four goat herds, and 3,984 from ten demonstration herds. In addition to the total number of samples tested, 52 were received in a condition unsuitable for testing.

Three of the State Institution herds were dispersed during the year. The percentage of *Str. agalactiae*-infected cows in the remaining 18 herds has increased slightly to 13.4, although nine of the herds are now free from the infection. Field reports from a number of these herds indicate that average milk production per cow has increased over a two-year period between 870 and 3,374 pounds. In large part this is credited to better mastitis control.

The University Farm Department herd has remained free from *Str. agalactiae* infection for more than three years.

Studies are being made to reduce the amount of work and testing time required to obtain accurate results.

A number of herds have been seriously troubled with pseudomonas

udder infections which have not responded favorably to treatment.

The number of herds testing more than once during the year is about double that of 1949 to 1950. This reflects the increased use of the diagnostic service by the dairymen and parallels the reduced mastitis in the herds.

PUBLICATIONS

Bulletins

459 Annual Report for the Fiscal Year Ending June 30, 1950. 92 pp. September 1950.

Control Bulletins

144 Inspection of Commercial Feedstuffs. By Feed Control Service Staff. 27 pp. May 1950.

145 Inspection of Commercial Fertilizers and Agricultural Lime Products. By Fertilizer Control Service Staff. 15 pp. July 1950.

146 Thirtieth Annual Report of Pullorum Disease Eradication in Massachusetts. By the Poultry Disease Control Laboratory. 11 pp. July 1950.

147 Seed Inspection. By Seed Control Service Staff. 29 pp. November 1950.

Meteorological Bulletins

733-748 Monthly reports of daily weather records, including monthly and annual summaries. H. N. Stapleton and E. F. Cox. 4 pp. each.

Reports of Investigations in Journals

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697 Cancelled.

706 Cancelled.

709 Phenotypic and genotypic selection of breeding females. F. A. Hays. Poultry Sci. 28 (3):467-469. May 1949.

714 *Escherichia coli* in digested sludge. J. E. Fuller and W. Litsky. Sewage and Indus. Wastes. 22 (7):853-859. July 1950.

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Erratum: *Top of page 42 should read:*

DEPARTMENT OF OLERICULTURE

Grant B. Snyder in Charge

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